% $Id: modes.mf,v 1.32 2026/01/03 18:54:07 karl Exp $
%
% Compiled 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 2002, 2004,
% 2005, 2008, 2020 by Karl Berry. This file is not copyrighted and may
% be used freely. You can retrieve the latest version from
% https://ctan.org/pkg/modes, among other places.
%
% For bug reports, discussion, or to submit a new **mode_def**, please
% send it to tex-k@tug.org (explanations below).
%
% For general discussion about METAFONT, the mailing list
% tex-fonts@math.utah.edu is a good place.
%
% Feel free to change the definitions of *localfont*, *screen_cols*,
% and *screen_rows* at the end of file (see explanations below).
%
% The mode definitions start at 'Here are the modes', several hundred
% lines down. The companion files modelist.txt and
% modenames.txt list the modes one per line, with and without comments.
%
% A common use for modes nowadays is to make high-resolution bitmaps from
% METAFONT-only fonts to include in PDF output or for autotracing. The
% *dpdfezzz* mode is an 8000 dpi mode with canonical parameter values,
% intended for this purpose. (Running dvips -Ppdf will use this.)
% If you want a lower resolution, similar canonical modes are *supre*
% at 2400 dpi and *ultre* at 1200 dpi.
%
% This file can be run through mft and TeX to produce a nice
% pretty-printed listing; the resulting modes.pdf file is included
% in the distribution.
%
% @mffile{
%   author = "The Metafont community",
%   version = "4.4",
%   date = "Sat Jan 3 10:55:17 PST 2026"
%   filename = "modes.mf",
%   email = "tex-k@tug.org"
%   checksum = "2675 13398 98050",
%   codetable = "ISO/ASCII",
%   supported = "yes",
%   docstring = "
%
% This file is a collection of putatively all extant METAFONT modes.
%
% If you have a device which is not mentioned in this file, the best
% thing to do is try to find a device with similar resolution (search
% for the appropriate lines), and see if that suits (a list of fonts to
% try is given above). Otherwise, methods for fiddling with the
% parameters are described in detail below.
%
% Unfortunately, the number of modes eats up a lot of memory; if your
% METAFONT has not increased the table sizes, you may need to remove
% some of the modes from this file (please rename it to something else then,

% e.g., `local.mf`). If you can suggest a way to redefine **mode_def**
% and/or **mode_setup**, even better; right now, the amount of memory
% used is approximately four times the length of the **mode_def** names.
%
% The primary names are strictly lowercase. This makes it feasible to use
% them for portable directory names, and the TEX Directory Structure
% standard recommends doing so. The synonyms are historical equivalents.
%
% It also makes definitions to put specials identifying the mode in
% the METAFONT GF output, and to put the coding scheme and
% other so-called Xerox-world information in the TFM output. This can
% be made to happen by calling **mode_include_extra_info**.
%
% It also defines a macro **landscape** that inverts *aspect_ratio* and
% changes *pixels_per_inch*, so you can say `mode := whatever;`
% `landscape; ...` to get landscape fonts. But I can't think of any
% reasonable way to reflect the **landscape** in the directory name, so
% there are also **mode_def**'s for the devices with non-square aspect
% ratios in landscape mode.
%
% Finally, it has some code to handle write-white devices better; this
% code comes into play if a **mode_def** includes the statement
% **mode_write_white_setup_**;. Such **mode_def**s should also define
% *blacker_min*. For further discussion of write/white and white/black
% devices, see Pierre MacKay's article in the proceedings of the
% 1991 Raster Imaging and Digital Typography conference:
%
```
% @String{proc-RIDT91 = "Raster Imaging and Digital Typography II"}
% @String{pub-CUP = "Cambridge University Press"}
%
% @Inproceedings{Mackay:RIDT91-205,
%   author =       "Pierre A. MacKay",
%   title =        "Looking at the Pixels:  Quality Control for 300 dpi
%                  Laser Printer Fonts, especially {METAFONT}s ",
%   pages =        "205--215",
%   crossref =     "Morris:RIDT91",
% }
%
% @Proceedings{Morris:RIDT91,
%   title =        proc-RIDT91,
%   booktitle =    proc-RIDT91,
%   year =         "1991",
%   editor =       "Robert A. Morris and Jacques Andr{é}",
%   publisher =    pub-CUP,
%   address =      pub-CUP:adr,
%   acknowledgement = ack-kb,
% }
```
%
% This file is typically loaded when making a METAFONT base; TEX Live does
% this by default, but to do it manually, for example, the command line
%   `inimf plain input modes dump`
% makes a file `plain.base` (or `plain.bas`, or something like that)
% with all the modes herein defined (plain itself defines modes called

% *proof*, *smoke*, and *lowres*.)
%
% You can make the Computer Modern base with the command line:
%   `inimf plain input modes input cmbase dump`
% It's generally best to avoid doing this, since it's
% easy to forget to update them. Just using `plain.base` is simplest.
%
% On Unix systems, you then install the base file in the system directory
% as `mf.base`. METAFONT uses the name it was invoked as to determine
% the format or base file to read; thus running `mf` reads
% `mf.base`, running `cmmf` reads `cmmf.base`, and so on.
% `plain.base` and `mf.base` should be the same file (either a hard
% or soft link is ok), so the examples in *The METAFONTbook* work.
%
% A user selects a particular mode when running METAFONT
% by assigning to the variable *mode*. For example:
%   `mf \mode:=cx; input cmr10`
% sets up values appropriate for the CanonCX engine.
%
% If no mode is assigned, the default is *proof* mode, as stated in
% *The METAFONTbook*. This is the cause of the "`.2602gf`" files which
% are the subject of periodic questions. The remedy is simply to assign
% a different mode—*localfont*, for example.
%
% Every site should define the mode *localfont* to be a synonym for the
% mode most commonly used. This file defines *localfont* to be *ljfour*.
% The values for *screen_rows* and *screen_cols*, which determine how big
% METAFONT's window for online output is, should perhaps also be
% changed; certainly individual users should change them to their
% own tastes.
%
% This file defines `?` to type out a list of all the known
% **mode_def**s (once only).
%
% Technically, a **mode_def** is a METAFONT definition that typically
% consists of a series of assignments to various device-specific variables,
% either primitive or defined in plain. These variables include the
% following (page numbers refer to *The METAFONTbook*:
%
% *aspect_ratio*: the ratio of the vertical resolution to the horizontal
% resolution (page 94).
%
% *blacker*: a correction added to the width of stems and similar
% features, to account for devices which would otherwise make them
% too light (page 93). (Write-white devices are best handled by a more
% sophisticated method than merely adding to *blacker*, as explained
% above.) Compare your results with a good high-resolution example,
% such as one of the volumes of *Computers & Typesetting*.
% If you compare against the output of a typical write-black 300 dpi
% engine, you will almost certainly wind up with something too dark.
% *blacker* should never be negative, the EC fonts do not compile with
% such a value.
%

% *fillin*: a correction factor for diagonals and other features which
% would otherwise be "filled in" (page 94). An ideal device would
% have *fillin* = 0 (page 94). Negative values for *fillin* typically
% have either gross effects or none at all, and should be avoided.
% Positive values lighten a diagonal line, negative values darken it.
% Changes in the *fillin* value tend to have abruptly non-linear effects
% on the various design-sizes and magnifications of a typeface.
%
% *fontmaking*: if nonzero at the end of the job, METAFONT writes
% a TFM file (page 315).
%
% *o_correction*: a correction factor for the "overshoot" of curves
% beyond the baseline or x-height. High resolution curves look better
% with overshoot, so such devices should have *o_correction* = 1; but
% at low resolutions, the overshoot appears to simply be a distortion
% (page 93). Here some additional comments about *o_correction*,
% courtesy of Pierre MacKay (edited by Karl):
%
% At present, I find that *o_correction* works nicely at 80 pixels per
% em, and gets increasingly disturbing as you move down towards 50
% pixels per em. Below that I do not think it ought to happen at all.
%
% The problem, of course, is that full *o_correction* is supposed to
% occur only at the zenith and nadir of the curve of 'o', which is
% a small region at high resolution, but may be a long line of
% horizontal pixels at medium resolution. The full *o_correction*
% does not change a 300 dpi `cmr10`, but it changes a 21-pixel
% high `cmr12` to be 23 pixels high. The extra height and depth
% is seen along a line of seven pixels at the bottom and five at
% the top. This is a pronounced overshoot indeed.
%
% For high-resolution devices, such as phototypesetters, the values
% for *blacker*, *fillin*, and *o_correction* don't matter all that much,
% so long as the values are within their normal ranges: between
% 0 and 1, with the values approaching 0, 0, and 1 respectively.
%
% *pixels_per_inch*: the horizontal resolution; the METAFONT primitive
% *hppp* (which is what determines the extension on the GF filename,
% as among other things) is computed from this (page 94). (An "inch"
% is 72.27 pt in the TEX world.)
%
% To be more precise, you can determine the resolution of a font given
% a **mode_def** and a magnification m by simply multiplying
% *pixels_per_inch* for that **mode_def** by m. (Your results may differ
% from METAFONT's if you don't use equivalent fixed-point arithmetic.)
% Then you can determine the number used in the name of the GF font
% output by rounding. For example, a font generated at magstep(.5)
% (which is $\sqrt{1.2}$, which METAFONT computes as 1.09544) for a printer
% with *pixels_per_inch* = 300 will have a resolution of 328.63312 dots
% per inch, and the GF filename will include the number `329`.
%
% *proofing*: says whether to put additional specials in the GF file for
% use in making proofsheets via, e.g., the utility program `GFtoDVI`

% (page 323–4).
%
% *tracingtitles*: if nonzero, strings that appear as METAFONT statements
% are typed on the terminal (page 187).
%
% Pierre MacKay `mackay@cs.washington.edu` has a collection of Unix
% tools to make up a minifont of indicator characters to help in testing.
%
% Neenie Billawala's article in the April 1987 issue of *TUGboat*
% describes how to test your printer for the best set of values for the
% magic numbers above. Here are some brief comments on the subject,
% courtesy of Rocky Bernstein and Paul Abrahams:
%
% For medium-to-low resolution devices, you can first set the *blacker*
% and *o_correction* to 0 and decide on a *fillin* value by looking at
% the diagonal of a lowercase 'z' in `cmtt10`, or various lines in
% LaTeX's `line10` font. The diagonal should be the same thickness
% as the horizontal bars of the 'z'. Then I decide on the *blacker*
% value, generally by checking the smaller fonts for too much filling
% in. Finally, you can set the *o_correction* using the guidelines
% suggested above.
%
% The easiest way to make a new **mode_def** is not by modifying this file
% and rebuilding your base file every time. Instead, use a separate file
% that contains the appropriate values for the mode parameters and read
% it in when running METAFONT. If you're using Dvips or another utility
% that calls `MakeTeXPK` to make PK files, remember you'll have to call
% METAFONT explicitly to make fonts until you've rebuilt the base files.
%
% To use a separate mode file with METAFONT, use the following
% command line:
%   `mf \smode:="newmode.mf"; mag:=magstep (2.0); input cmr10`
% substituting whatever font and magnification you wish, or omitting
% the magnification altogether.
%
% The file `newmode.mf` should contain lines like this (with no
% **mode_def** or **enddef**):
%   `mode_param (pixels_per_inch, 100);`
%   `mode_param (blacker, 0);`
%   `mode_param (fillin, 0);`
%   `mode_param (o_correction, 1);`
%   `mode_common_setup_;`
% changing the values as appropriate, of course. Once you're satisfied
% with the parameters, use inimf as described below to rebuild and
% install the plain (and any other) base files.
%
% For more information on the use of *smode*, see page 269 of
% *The METAFONTbook*.
%
% Matt Swift has contributed a short TEX file to help in testing new
% modes. Remember to remove a leading `"%% "` from each line after
% extracting it. (Only a single % is shown in the printed version.)
% If you don't use this file for testing, please mention what fonts

```
% at what sizes you tested your new mode on. This will help other
% people wondering where particular values came from. Ideally,
% you would try normal, bold, and italic variants, at sizes around
% 5 pt, 10 pt and 15 pt.
%
% % modetest.tex               -- a file to test a METAFONT mode
% %
% % by Matt Swift <swift@alum.mit.edu>
% %
% % This file is in the public domain.
% %
% % \def\fileversion{v1.2}
% % \def\filedate{1995/12/31}
% %
% % This LaTeX 2e file generates a test page useful for finding a good
% % METAFONT mode for your printer.  It includes the most sensitive
% % letters in three sizes and all standard CMR font shapes.
% %
% % I've made the macros abstract, and I think this file could easily
% % be adapted to test modes for other METAFONT fonts, or simply font
% % appearance in general.
% %
% % If you want to adapt this to a non-LaTeX format, the LaTeX-specific
% % commands below that must be altered are \documentclass,
% % \begin{document}, \end{document}, \makeatletter, \makeatother,
% % \@for, \@setfontsize, \encodingdefault, \pagestyle, \normalfont,
% % \rmfamily, \sffamily, \ttfamily, \mdseries, \bfseries, \upshape,
% % \itshape, \scshape, and \slshape.
%
% \def\encodingdefault{T1}  % New "Cork" font encoding (dc fonts).
% \def\encodingdefault{OT1} % Old font encoding (cm fonts).
%
% \documentclass{article}
% \begin{document}
%
% % This line can be replaced (by, e.g., sed) to contain a mode name.
%
% ::Mode::
%
% \def\makesize#1#2#3{
%   \expandafter\def\csname ptsize#1\endcsname{#2}
%   \expandafter\def\csname blsize#1\endcsname{#3}
% }
%
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %  DEFINE HERE THE POINT SIZES with baselineskips you would like to test.  %
% %  With the defaults of 5, 10, and 14 point sizes, everything will fit on  %
% %  one page very easily.  Twocolumn would allow several more sizes.        %
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%
% \makesize {A}{5}{6}
% \makesize {B}{10}{12}
% \makesize {C}{14}{18}
```

```
%
% \def\sizelist{A,B,C}
%
% \def\letters{%
% MoOzZffii-a\"egsS [/$\backslash$\par
% }
%
% \makeatletter
% \let\setfontsize\@setfontsize
% \let\for\@for
% \parindent\z@
% \makeatother
%
% \pagestyle{empty}
%
% \def\showfonts{%
% %
% % The groups prevent warnings when intermediate fonts are not available.
% %
% {\rmfamily \mdseries \upshape \letters}  % allow no space before this
%   {\rmfamily \mdseries \slshape \letters}
%   {\rmfamily \mdseries \itshape \letters}
%   {\rmfamily \mdseries \scshape \letters}
%
%   {\rmfamily \bfseries \upshape \letters}
%   {\rmfamily \bfseries \slshape \letters}
%   {\rmfamily \bfseries \itshape \letters}
%
%   {\sffamily \mdseries \upshape \letters}
%   {\sffamily \mdseries \slshape \letters}
%
%   {\sffamily \bfseries \upshape \letters}
%
%   {\ttfamily \mdseries \upshape \letters}
%   {\ttfamily \mdseries \slshape \letters}
%   {\ttfamily \mdseries \itshape \letters}
%   {\ttfamily \mdseries \scshape \letters}
% }
%
% % The \expandafters expand \sizelist.
% %
% \expandafter   \for
% \expandafter   \sizename
% \expandafter   :%
% \expandafter   =%
%                \sizelist
%   \do {\setfontsize {\sizename}
%                     {\csname ptsize\sizename\endcsname}
%                     {\csname blsize\sizename\endcsname}%
%       \vskip 1ex\noindent
%       \llap{\normalfont\csname ptsize\sizename \endcsname\,pt\quad}%
%       \showfonts}
%
```

% `\end{document}`
% `% end of modetest.tex`
%
%"
% `}`

% Don't let ourselves be processed twice.
if known *modes_mf*: **endinput**; **fi**;
modes_mf := 4.4;

% Identify ourselves in the format file.
base_version := *base_version* & `"/modes 4.4"`;

% Here are useful macros (also called definitions) we use throughout.

% First, some comments about how the *mode_defs* are constructed (from
% `rocky@panix.com`). In the past, *mode_defs* unconditionally
% assigned a value to the various mode-dependent parameters.
% For example, they contained an assignment *fontmaking* := 1, which
% tells METAFONT to write a TFM file.
%
% But suppose you want to generate a font using all of the setup for
% some mode m, but do not want to generate a TFM? One could create
% another mode that doesn't have the assignment, but this seems a bit
% wasteful since the rest of the code in the mode would be duplicated.
% Furthermore, given the way the mode definitions were written, it was
% not possible to change the mode parameters. To see why, I review how
% a METAFONT run typically works.
%
% First, METAFONT is invoked with some base file to load. Then you might
% want give additional instructions, such as **scrollmode**, or *mode* := *cx*.
% Next, you input a parameter file, say `cmr10`. The parameter file
% calls a driver file such as `roman.mf` with the command
% **generate** `roman`. Finally, the driver finishes with **bye** or **end**.
% Thus, any additional commands you give after the input of the
% parameter file are ignored.
%
% Usually, one of the first things a driver file does is to call
% **mode_setup**. It is here that the mode parameters are set. (In our
% hypothetical mode, it would be here that *fontmaking* is assigned.)
%
% To allow a flexible setting of *fontmaking*, we can make a simple
% change: in the **mode_def**, first test to see if a value has been
% defined prior and only make the assignment if not. That is:
% **if** unknown *fontmaking*: *fontmaking* := 1; **fi**.
%
% Alas, this doesn't work. Primitives, like *fontmaking*, are always
% known. So instead we create "guard" variables, specifically,
% *mode_guard_fontmaking*; we set the guard when we assign the
% parameter. Then we test whether the guard is known before we
% actually do an assignment. This allows more flexible definitions: you
% can specify some of the parameters, and keep the defaults for others.
%
% It is also possible to write a program that creates a **mode_def**
% on the fly. Although useful, this has a slightly different focus

```
% than starting with an existing mode_def and changing a couple
% of parameters. In particular, one still has to peek inside the
% file to see what the old values were and set them again (in the
% new context). Also, such on-the-fly mode_def generation programs
% are inherently less machine-independent than a scheme that does
% everything in METAFONT itself.
%
% The upshot of all this is the following: we say, e.g.,
% mode_param(fontmaking, 1) below, instead of using the assignment
% primitive directly. The name ("mode_param") is kept somewhat
% short because you can also use this to override a mode assignment
% on the command line or in response to the ** prompt.

def mode_param(suffix v)(expr e) =
    if unknown mode_guard_.v:
        v := e;
        mode_guard_.v := 1;
    fi
enddef;

% This macro is invoked by all the modes, after pixels_per_inch
% has been defined, thus saving some space and time.
def mode_common_setup_ =
    mode_param(proofing, 0);
    mode_param(fontmaking, 1);
    mode_param(tracingtitles, if pixels_per_inch > 1200: 1 else: 0 fi);
enddef;

% In a similar spirit, here are definitions to change to "landscape"
% mode. You just say mode := whatever; landscape; ...,
% and when mode_setup is executed, the aspect_ratio will be
% inverted, and pixels_per_inch changed.
def landscape =
    extra_setup := extra_setup & "landscape_;"
enddef;

def landscape_ =
    begingroup
        interim warningcheck := 0;
        pixels_per_inch := aspect_ratio * pixels_per_inch;
        aspect_ratio := 1/aspect_ratio;
        fix_units; % Too bad we can't do this after any extra_setup.
    endgroup
enddef;

% Here are macros to add specials with mode information to the GF file.
%
% Specifically, we add the pixels_per_inch, o_correction,
% aspect_ratio (if not 1), mag, fillin, and mode_def name. This
% information can be used to automatically verify that a font file name
% matches the specification within the file. For example, you could
% check that the number in the filename matches mag * pixels_per_inch.
% Or, if the mode_def name is part of the font directory path
% (e.g., you put fonts in .../texmf/fonts/pk/cx), that all of the
% bitmap files in the directory have the expected mode_def name.
```

```
def mode_special_(suffix $) =
    string s, d;
    s := str $;
    d := decimal scantokens s;
    special s & "=" & d;
enddef;

def mode_output_specials_ =
    begingroup
        save d, s, p, p_p_i;
        string p;

        interim warningcheck := 0; % In case pixels_per_inch > 4096.

        % We need the old pixels_per_inch to compute
        % the true device resolution.
        p_p_i = pixels_per_inch/mag;

        % But now we want to change pixels_per_inch,
        % so save the old value.
        save pixels_per_inch;
        pixels_per_inch := p_p_i;

        special "jobname=" & jobname;
        mode_special_(mag);

        p := if string mode:
                    mode
                else:
                    substring(0, length(mode_name[mode]) - 1) of mode_name[mode]
                fi;
        special "mode=" & p;

        mode_special_(pixels_per_inch);
        if aspect_ratio ≠ 1:
            mode_special_(aspect_ratio);
        fi;
        mode_special_(blacker);
        mode_special_(fillin);
        mode_special_(o_correction);
    endgroup
enddef;

% Here are macros for Xerox-world font info, which can be useful even
% if you never use a Xerox printer. For instance, crudetype uses
% the coding_scheme and it is nice to have the font family on record.
% This goes into both the TFM file (as headerbyte information), and
% into the GF file (as a special).

% Make the string s be n bytes long.
def BCPL_string(expr s, n) =
    for l := if length(s) ≥ n: n - 1 else: length(s) fi: l
        for k := 1 upto l: , substring(k - 1, k) of s endfor
        for k := l + 2 upto n: , 0 endfor
    endfor
enddef;

% The string s names the encoding scheme, e.g., TeX text.
```

```
def coding_scheme expr s =
    headerbyte 9: BCPL_string(s, 40);
    special "codingscheme=" & s
enddef;

% The string s names the font family, e.g., CMR.
def font_family expr s =
    headerbyte 49: BCPL_string(s, 20);
    special "fontid=" & s
enddef;

% The integer x gives the family member number, which should be
% between 0 and 255.
def font_face_byte expr x =
    headerbyte 72: x;
    special "fontfacebyte";
    numspecial x
enddef;

% So users can say if known Xerox_world: ... fi, per The METAFONTbook.
Xerox_world := 1;

% For users who want extra information in the output file.
% This used to be done automatically by redefining end, but DEK reported
% that as a serious bug on 19 February 2008 to tex-implementors.
%
def mode_extra_info =
    if fontmaking > 0:
        font_family font_identifier_;
        coding_scheme font_coding_scheme_;
        font_face_byte max(0, 254 - round 2designsize);
        mode_output_specials_;
    fi;
enddef;

% This macro mode_include_extra_info will insert the above extra
% information, most importantly the coding_scheme, upon end.
% This is called from the mktextfm and mktexpk scripts if
% the environment variable MF_MODE_EXTRA_INFO is set; the
% mftrace program (https://ctan.org/pkg/mftrace) can use this.
%
% We need to redefine end in the macro to output the information, so
% save the primitive meaning. And we must make both end and bye
% inner tokens, so we can define them in the macro.
%
let original_end_ = end;
inner end, bye;
%
def mode_include_extra_info =
    def end =
        mode_extra_info;
        original_end_;
    enddef;

    % The METAFONTbook gives bye two different definitions (on pages
    % 278 and 321). The first is used in plain.mf and is merely
```

```
    % a synoynym for the primitive end. The second, which is not part
    % of plain.mf, is similar to the code given above. We want the
    % extra information to get into the output files regardless of whether
    % the METAFONT source used end or bye. We just changed end;
    % now we have to redefine bye again (as on page 278).
    let bye = end;
enddef;

% This is tested in mktextfm with known to see if it is ok to
% call mode_include_extra_info, since there is apparently no way to test
% whether a macro is defined, unlike TeX.
boolean mode_include_extra_info_available;
mode_include_extra_info_available := true;

% Now make end and bye outer again; it seems let does not
% restore this attribute.
%
outer end, bye;

% Here are macros to handle write-white devices.
%
% The basic correction for write-white fonts occurs in the definition
% of font_setup. This can be used to extend or change the write-black
% definition in Computer Modern's cmbase.mf or other base files
% based on CM, such as dxbase.mf. This has no effect at 1200 dpi.
def mode_write_white_setup_ =
    newinternal blacker_min;
    def define_whole_blacker_pixels(text t) =
                forsuffixes $ = t: $ := hround($# * hppp + blacker);
                        if $ ≤ blacker_min − 1: $ := blacker_min; fi endfor enddef;

    def define_whole_vertical_blacker_pixels(text t) =
                forsuffixes $ = t: $ := vround($# * hppp + blacker);
                        if $ ≤ blacker_min − 1: $ := blacker_min_o_; fi endfor enddef;

    % Only do the above once, in case a font file (unnecessarily)
    % calls mode_setup more than once.
    let mode_write_white_setup_ = relax
enddef;
```

```
% Here are the modes, given mostly in alphabetical order.

% From J.Hicks@warwick.ac.uk.
mode_def agfafzz =                                          % AGFA 400PS (406dpi)
    mode_param(pixels_per_inch, 406);
    mode_param(blacker, .2);
    mode_param(fillin, 0);
    mode_param(o_correction, .6);
    mode_common_setup_;
enddef;
AgfaFourZeroZero := agfafzz;

% From picheral@univ-rennes1.fr.
mode_def agfatfzz =                                         % AGFA P3400PS (400dpi)
    mode_param(pixels_per_inch, 400);
    cx_;
enddef;
AgfaThreeFourZeroZero := agfatfzz;

% From rokicki@neon.stanford.edu.
mode_def amiga =                                            % Commodore Amiga (100dpi)
    mode_param(pixels_per_inch, 100);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;
onezz := amiga;
OneZeroZero := amiga;

mode_def aps =                                              % Autologic APS-Micro5 (723dpi)
    mode_param(pixels_per_inch, 722.909);
    mode_param(blacker, .2);
    mode_param(fillin, .2);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;

% From rocky@panix.com. Tested on the single APS-6 at IBM Research.
mode_def apssixhi =                                         % Autologic APS-Micro6 (1016dpi)
    mode_param(pixels_per_inch, 1016);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;

% From ee@dacth51.bitnet.
mode_def atariezf =                                         % Atari ST SLM 804 printer (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, 0);
    mode_param(fillin, .5);
    mode_param(o_correction, 0);
    mode_param(blacker_min, 2);
    mode_common_setup_;
    mode_write_white_setup_;
```

```
enddef;
AtariSLMEightZeroFour := atariezf;

% From W.Spit@fys.ruu.nl. N.Poppelier@elsevier.nl says that
% different previewers use different resolutions (95 dpi, 96 dpi,
% or 101 dpi), but no one seems to know what the real resolution is.
mode_def atarinf =                                  % Atari previewer (95dpi)
    mode_param(pixels_per_inch, 95);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 0.1);
    mode_common_setup_;
enddef;
AtariNineFive := atarinf;

mode_def atarins =                                  % Atari previewer (96dpi)
    mode_param(pixels_per_inch, 96);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 0.1);
    mode_common_setup_;
enddef;
AtariNineSix := atarins;

% From ee@dacth51.bitnet.
mode_def atariotf =                                 % Atari ST SM 124 screen (101dpi)
    mode_param(pixels_per_inch, 101);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .4);
    mode_common_setup_;
enddef;
AtariSMOneTwoFour := atariotf;

mode_def bitgraph =                                 % BBN Bitgraph (118dpi)
    mode_param(pixels_per_inch, 118);
    mode_param(blacker, .55);
    mode_param(fillin, .1);
    mode_param(o_correction, .3);
    mode_common_setup_;
enddef;

% From sjwright@cix.compulink.co.uk, 9 February 1994.
mode_def bjtenex =                                  % Canon BubbleJet 10ex (360dpi)
    mode_param(pixels_per_inch, 360);
    mode_param(blacker, .6);
    mode_param(fillin, 0);
    mode_param(o_correction, .6);
    mode_common_setup_;
enddef;

% cgweav@eskimo.com (Clayton Weaver), 4 February 1997.
% Might want to recheck o_correction, which could vary per unit.
mode_def bjtzzex =                                  % Canon BubbleJet 200ex (360 dpi)
    mode_param(pixels_per_inch, 360);
    mode_param(blacker, 1.2);
```

```
    mode_param(fillin, .2);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;

% Alastair.Jenkins@nrsc.no, 30 January 1997.
mode_def bjtzzs =                                   % Canon BubbleJet 200 (720x360dpi)
    mode_param(pixels_per_inch, 720);
    mode_param(aspect_ratio, 0.5);
    mode_param(blacker, 0.0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1.0);
    mode_common_setup_;
enddef;

% Alastair.Jenkins@nrsc.no, 30 January 1997.
mode_def bjtzzl =                                   % BubbleJet 200 landscape (360x720 dpi)
    bjtzzs_;
    landscape;
enddef;

mode_def boise =                                    % HP 2680A (180dpi)
    mode_param(pixels_per_inch, 180);
    mode_param(blacker, .55);
    mode_param(fillin, .1);
    mode_param(o_correction, .3);
    mode_common_setup_;
enddef;

% From Yves.Arrouye@imag.fr.
mode_def canonbjc =                                 % Canon BJC-600 (360dpi)
    mode_param(pixels_per_inch, 360);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .8);
    mode_common_setup_;
enddef;
CanonBJCSixZeroZero := canonbjc;

% From swartz@cs.wisc.edu, 8 April 1993. The straightforward
% mode with blacker = 0, fillin = 0, o_correction = 1 seems to
% work fine for the Canon EX engine inside Apple's LaserWriter Pro 630.
% It produces light, clear lines and type. But ajcarr@ccvax.ucd.ie
% sent in the revised values below on 12 December 1993, tested on
% the major CM fonts at 5, 7, and 10 pt and producing slightly
% better results.
mode_def canonex =                                  % LaserWriter Pro 630 (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, .2);
    mode_param(fillin, .1);
    mode_param(o_correction, .85);
    mode_common_setup_;
enddef;
CanonEX := canonex;

mode_def canonlbp =                                 % Symbolics LGP-10 (240dpi)
```

```
    mode_param(pixels_per_inch, 240);
    mode_param(blacker, .2);
    mode_param(fillin, .2);
    mode_param(o_correction, .4);
    mode_common_setup_;
enddef;
CanonLBPTen := canonlbp;

% This is really 1301.5; MF produces 1301, so use that.
mode_def cg =                                   % Compugraphic 8600 (1301x1569dpi)
    mode_param(pixels_per_inch, 1301);
    mode_param(aspect_ratio, 1569/pixels_per_inch);
    mode_param(blacker, .2);
    mode_param(fillin, .2);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
CompugraphicEightSixZeroZero := cg;

mode_def cgl =                                  % Compugraphic 8600 landscape (1569x1302dpi)
    cg_;
    landscape;
enddef;

% These values from Linotype Linotronic [13]00 modified to 1200 dpi.
% From wagman%muse.hepnet@Csa2.LBL.Gov.
mode_def cgnszz =                               % Compugraphic 9600 (1200dpi)
    mode_param(pixels_per_inch, 1200);
    mode_param(blacker, .65);
    mode_param(fillin, -.1);
    mode_param(o_correction, .5);
    mode_common_setup_;
enddef;
CompugraphicNineSixZeroZero := cgnszz;

% This has a resolution of 5333 + 1/3 pixels per inch.
mode_def crs =                                  % Alphatype CRS (5333dpi)
    mode_param(pixels_per_inch, 4000 + 4000/3);
    mode_param(blacker, 4);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;

% This applies to the LaserWriter Plus, HP LaserJet, HP LaserJet Plus,
% and also the Canon LBP-LX engine, in the LaserJet IIP, QMS 410,
% and Apple Personal LaserWriter, and also to the CanonSX engine,
% in the LaserWriter II family. And hammond@jila02.Colorado.EDU
% says it works well for the "enhanced-resolution" LaserJet III.
% swartz@cs.wisc.edu is developing a mode for the Canon EX engine
% inside an Apple Pro 630 printer.
mode_def cx =                                   % Canon CX, SX, LBP-LX (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, 0);
    mode_param(fillin, .2);
    mode_param(o_correction, .6);
```

```
    mode_common_setup_;
enddef;
CanonCX := cx;
corona := cx;
dp := cx; % some kind of DataProducts
hplaser := cx;
imagen := cx;
kyocera := cx;
laserwriter := cx;
% I have seen a claim the LaserJet II was the Canon SX
% write-white engine, but I don't think that's right.
laserjethi := cx;
laserjet := cx;
% ogawa@orion.arc.nasa.gov says that this is definitely not a
% write-white engine, despite earlier versions of this file claiming
% the contrary. Thus, probably the same parameters as cx will do.
CanonSX := cx;
CanonLBPLX := cx;

% At least magstep 2 is recommended at this low resolution.
mode_def datadisc =                                   % DataDisc (70dpi)
    mode_param(pixels_per_inch, 70);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;
DD := datadisc;

mode_def newdd =                                      % DataDisc (70x93dpi)
    mode_param(aspect_ratio, 4/3);
    datadisc_;
enddef;
DataDiscNew := newdd;

mode_def newddl =                                     % DataDisc landscape (93x70dpi)
    newdd_;
    landscape;
enddef;

% From mcgrant@rascals.stanford.edu. True resolution is 98.2236
% by 102.4. See comments for DECsmall just above.
mode_def declarge =                                   % DEC 19-inch, 1280 x 1024 (100dpi)
    mode_param(pixels_per_inch, 100);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;
DEClarge := declarge;
elvira := declarge;

% From mcgrant@rascals.stanford.edu. True resolution is 78.1069
% by 86.0612, but a square aspect ratio works better; furthermore,
% Computer Modern isn't prepared to deal with fractional pixel values.
mode_def decsmall =                                   % DEC 17-inch, 1024 x 768 (82dpi)
```

```
    mode_param(pixels_per_inch, 82);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;
DECsmall := decsmall;

% From fieberjr@whitman.bitnet.
mode_def deskjet =                                  % HP DeskJet 500 (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .6);
    mode_common_setup_;
enddef;
HPDeskJet := deskjet;

% From stsmith@ll.mit.edu, 10 May 93.
% With fillin = 0, the diagonal of cmtt10's 'z' is too thin.
% blacker = .8 too thin, 2 too thick.
mode_def docutech =                                 % Xerox 8790 or 4045 (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, 1);
    mode_param(fillin, .1);
    mode_param(o_correction, 0.9);
    mode_common_setup_;
enddef;
XeroxDocutech := docutech;

% From waits.mf.
mode_def dover =                                    % Xerox Dover (384dpi)
    mode_param(pixels_per_inch, 384);
    mode_param(blacker, 1.2);
    mode_param(fillin, 0);
    mode_param(o_correction, .6);
    mode_common_setup_;
enddef;

% Reported by Silas Brown, 4 April 2003, via Debian bug 184875.
% dvips -Ppdf wants 8000 dpi fonts, so define a mode for that.
mode_def dpdfezzz =                                 % dvips -Ppdf (8000dpi)
    mode_param(pixels_per_inch, 4000 * 2);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
pdf := dpdfezzz; % mentioned in 2026 mf.man, for simplicity

% ghibo@galileo.polito.it, for the Amiga ShowDVI previewer.
mode_def eighthre =                                 % EightThree (83dpi)
  mode_param(pixels_per_inch, 83);
  mode_param(blacker, 0);
  mode_param(fillin, 0);
  mode_param(o_correction, .2);
```

```
  mode_common_setup_;
enddef;
EightThree := eighthre;

% arno.wagner@acm.org, 25 November 1997. To print in 360dpi (much
% faster, but lower quality) use the epstylus mode instead. This
% printer seems to make smaller dots when printing at 720 dpi and
% larger ones when printing at 360 dpi. I tried 720x1440 resolution
% as well, but found it not worth the additional time. If you use
% Ghostscript, you need at least version 5.03 to support 720 dpi on
% this printer. This mode may work with the Epson Stylus color 800 as
% well. I tested this mode with Matt Swift's test, found above.
% With fillin set to zero, the test had no 'át 5 pt.
%
mode_def epscszz =                                  % Epson Stylus Color 600 (720 dpi)
    mode_param(pixels_per_inch, 720);
    mode_param(blacker, .25);
    mode_param(fillin, 0.5);
    mode_param(o_correction, .8);
    mode_common_setup_;
enddef;

% From metcalf@catfish.LCS.MIT.EDU, 5 Dec 1992.
mode_def epsdrft =                                  % Epson (120x72dpi)
    mode_param(pixels_per_inch, 120);
    mode_param(aspect_ratio, 72/pixels_per_inch);
    epson_;
enddef;
epsdraft := epsdrft;

mode_def epsdrftl =                                 % Epson (72x120dpi)
    epsdrft_;
    landscape;
enddef;

% From metcalf@catfish.LCS.MIT.EDU, 5 Dec 1992.
mode_def epsfast =                                  % Epson fast (60x72dpi)
    mode_param(pixels_per_inch, 60);
    mode_param(aspect_ratio, 72/pixels_per_inch);
    epson_;
enddef;

mode_def epsfastl =                                 % Epson fast landscape (72x60dpi)
    epsfast_;
    landscape;
enddef;

% From Hippocrates Sendoukas <isendo@mail.ariadne-t.gr>, 17 April 1999.
mode_def epsmed =                                   % Epson med MX/FX 9-pin (240x144dpi)
    mode_param(pixels_per_inch, 240);
    mode_param(aspect_ratio, 144/pixels_per_inch);
    epson_;
enddef;

mode_def epsmedl =                                  % Epson med MX/FX 9-pin landscape (144x240dpi)
    epsmed_;
    landscape;
```

```
enddef;

% These values from Charles Karney, TUGboat 8(2), page 133. This
% is for the Epson MX/FX family (-85, -286), which are 9-pin printers.
% The 24-pin LQ family have higher resolutions; no one has sent me
% definitions for them yet. Ditto for Epson's laser printer.
% (Thanks to cargo@escargot.cray.com for all this information.)
mode_def epson =                                % Epson MX/FX 9-pin (240x216dpi)
    mode_param(pixels_per_inch, 240);
    mode_param(aspect_ratio, 216/pixels_per_inch);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;
EpsonMXFX := epson;
epshi := epson;
epsonfx := epson;

mode_def epsonl =                               % Epson MX/FX 9-pin landscape (216x240dpi)
    epson_;
    landscape;
enddef;

% From sdh@po.cwru.edu, 6 September 93.
% The modes cx and HPLaserJetIIISi are too spindly.
% This works (not awesome, o's and e's are slightly taller than
% they should be in large pt. fonts) on my Epson Action Laser 1500
% with LaserJetIIIsi emulation and RITech (Epson's Resolution
% Enhancement). It might work for the model 1000 or some HP's.
mode_def epsonact =                             % Epson Action Laser 1500 (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .8);
    mode_param(fillin, 0);
    mode_param(o_correction, 0.95);
    mode_common_setup_;
enddef;
EpsonAction := epsonact;

% Corrected to 216 dpi vertically, 5 Dec 1992.
% From metcalf@catfish.LCS.MIT.EDU.
mode_def epsonlo =                              % Epson (120x216dpi)
    mode_param(pixels_per_inch, 120);
    mode_param(aspect_ratio, 216/pixels_per_inch);
    epson_;
enddef;
epslo := epsonlo;

mode_def epsonlol =                             % Epson landscape (216x120dpi)
    epsonlo_;
    landscape;
enddef;

% From Sebastian_Kirsch@kl.maus.de, 19 April 1996. In comparison
% to some postscript fonts, the characters seemed to light with blacker
% 0, but much too heavy with a blacker greater than 1. I tried blacker
```

```
% .6 and finally settled for .7. All the other values are rather
% fictional, I didn't really test them out.
mode_def epsonsq =                                    % Epson SQ 870 (360dpi)
    mode_param(proofing, 0)
    mode_param(pixels_per_inch, 360);
    mode_param(blacker, .7);
    mode_param(fillin, .2);
    mode_param(o_correction, .9);
    mode_common_setup_;
enddef;
EpsonSQEightSevenZero := epsonsq;

% Following three modes from marc@mpi.nl (Marc Fleischeuers).
% I could not quite get the 'z' diagonal to get as thin as the
% horizontal lines, even pushing fillin up to 0.8. This printer tends
% to make things lighter on lower resolutions so I compensate a little
% with increasing blacker. But not all the way, as this would fill in
% the little holes in the 'e' and 's' at 5 pt. Otherwise it's pretty
% cool, not as crisp as an ljfour but better than most inkjets I've seen.
mode_def epstypro =                                   % Epson Stylus Pro (360dpi)
    mode_param(pixels_per_inch, 360);
    mode_param(blacker, 0.2);
    mode_param(fillin, 0.8);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;
EpsonStylusPro := epstypro;

mode_def epstyplo =                                   % Epson Stylus Pro (180dpi)
    mode_param(pixels_per_inch, 180);
    mode_param(blacker, .35);
    mode_param(fillin, 0.8);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;
EpsonStylusProLow := epstyplo;

% Good time saver, almost as good as 720x720 but a lot faster.
mode_def epstypmd =                                   % Epson Stylus Pro (720x360dpi)
    mode_param(pixels_per_inch, 720);
    mode_param(aspect_ratio, 360/pixels_per_inch);
    mode_param(blacker, 0);
    mode_param(fillin, 0.8);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;
EpsonStylusProMed := epstypmd;

mode_def epstypml =                                   % Epson Stylus Pro landscape (360x720dpi)
    epstypmd_;
    landscape;
enddef;
epstypmdl := epstypml;

mode_def epswlo =                                     % Epson low MX/FX 9-pin (120x144dpi)
    mode_param(pixels_per_inch, 120);
```

```
    mode_param(aspect_ratio, 144/pixels_per_inch);
    epson_;
enddef;

mode_def epswlol =                                  % Epson low MX/FX 9-pin landscape (144x120dpi)
    epswlo_;
    landscape;
enddef;

mode_def esphi =                                    % Epson Stylus Pro (720dpi)
    mode_param(pixels_per_inch, 720);
    mode_param(blacker, 0);
    mode_param(fillin, 0.8);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
EpsonStylusProHigh := esphi;

% From Tobias.Guenzler@uni-konstanz.de, 8 December 1994.
%
% The blacker parameter is the most critical; changing o_correction
% has lesser effect, and may also be increased or decreased somewhat.
% I tested this by comparing output with printouts of a HP LaserJet
% printer using the LJ fonts. This printer had the fancy resolution
% enhancement feature (RET) which makes the pixel steps almost
% invisible. I did most of the comparison with cmr12, cmbx12,
% cmr12 magstep2 and cmss9.
%
% The Stylus printer is a ink printer, but it works with a piezo drive
% instead of a bubble jet. This may be the reason why it draws its lines
% very tiny and thin. At least the pixel diameters are very sharp and
% they are far away from that bulky dots produced by the needles of
% a NEC P6.
mode_def epstylus =                                 % Epson Stylus (360dpi)
    mode_param(pixels_per_inch, 360);
    mode_param(blacker, .35);
    mode_param(fillin, 0);
    mode_param(o_correction, .8);
    mode_common_setup_;
enddef;

% ghibo@galileo.polito.it, for the Amiga ShowDVI previewer.
mode_def fourfour =                                 % FourFour (44dpi)
  mode_param(pixels_per_inch, 44);
  mode_param(blacker, 0.05);
  mode_param(fillin, .1);
  mode_param(o_correction, .2);
  mode_common_setup_;
enddef;
FourFour := fourfour;

% From drstrip@intvax.uucp.
% Revised by dak@pool.informatik.rwth-aachen.de, 24 May 1994.
mode_def gtfax =                                    % G3fax (204x196dpi)
    mode_param(pixels_per_inch, 204);
    mode_param(aspect_ratio, 196/pixels_per_inch);
```

```
    mode_param(blacker, 0);
    mode_param(fillin, .2);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;
GThreefax := gtfax;
gtfaxhi := GThreefax;

mode_def gtfaxl =                                   % G3fax landscape (196x204dpi)
    gtfax_;
    landscape;
enddef;

% From dak@pool.informatik.rwth-aachen.de, 24 May 1994.
mode_def gtfaxlo =                                  % G3fax (204x98dpi)
    mode_param(pixels_per_inch, 204);
    mode_param(aspect_ratio, 98/pixels_per_inch);
    gtfax_;
enddef;

mode_def gtfaxlol =                                 % G3fax landscape (98x204dpi)
    gtfaxlo_;
    landscape;
enddef;

% ron@mlfarm.com, 30 October 1995.
mode_def highfax =                                  % G3fax (200dpi)
    mode_param(pixels_per_inch, 200);
    mode_param(blacker, 0);
    mode_param(fillin, .2);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;
hifax := highfax;

% Martin Ruckert, 7 September 2020.
% 600dpi is much higher resolution than currently available on laptops
% or mobile devices, but they do do antialiasing. Here are some words
% from Martin about it:
%
% PK fonts are strictly black and white. On real paper, the ink dots will
% be fuzzy at the edges smoothing the outline. On electronic devices, a
% black and white font does look jagged (unless the device resolution is
% very high). So it is better to produce a black and white font at a
% higher resolution and let the graphics card scale it down to the device
% resolution. At the edges then one device pixel will correspond to
% several font pixels and the graphics card will average over these pixels
% and produce a gray value. The fonts then look much smoother. 600dpi is a
% good compromise. The font is not too big, and it will still look nice.
% If the device resolution is e.g. only 300dpi, 4 pixel in the font will
% map to one pixel on the screen. So around the edges you get 5 different
% gray-levels from all black (0) to all white (4). If the device
% resolution is even lower, the shading at the edges uses even more gray
% values. blacker is the only parameter with much effect here.
mode_def hitexlaptop =                              % HiTEX (HINT) laptop (600dpi)
    mode_param(pixels_per_inch, 600);
```

```
    mode_param(blacker, 0.6);
    mode_param(fillin, 0.2);
    mode_param(o_correction, .4);
    mode_common_setup_;
enddef;

% Martin Ruckert, 7 September 2020. See above.
mode_def hitexmobile =                                  % HiTEX (HINT) mobile (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, 1.6);
    mode_param(fillin, 0.2);
    mode_param(o_correction, .4);
    mode_common_setup_;
enddef;

% brumski+@osu.edu, 27 August 1993.
mode_def hprugged =                                     % HP RuggedWriter 480 (180dpi)
    mode_param(pixels_per_inch, 180);
    mode_param(blacker, .55);
    mode_param(fillin, .1);
    mode_param(o_correction, .3);
    mode_common_setup_;
enddef;

% Some general comments on the IBM printers, courtesy of rocky@panix.com.
%
% IBM 3820's, 3825's, 3827's and 3835's have some sort of corner imaging
% or shading that the IBM 3812's and 3816's don't. The latter two models
% may get this feature in the future.
%
% The IBM 3827 is made by Kodak, the rest are IBM engines.
%
% Some of the other printers have a knob that allows a service engineer
% to set one of up to ten levels of darkness. At IBM Research, we run
% very black. The service engineer sets the level by running a completely
% black page and then two completely blank ones. The black page
% must be black and the following two must be completely white.
%
% Thanks to Jim Hafner (hafner@ibm.com) for experimenting with
% blacker, and Paul Dantzig for information about these printers.
%
% From ARNALDO@RIOSC.bitnet. This is for the 3820, but can be used
% for 3812, 3816, 3825, 3837 3800 and 3827 printers (these are all
% 240 pels IBM printers that use the same font format when driven
% by PSF/VM).
mode_def ibm_a =                                        % IBM 38xx (240dpi)
    mode_param(pixels_per_inch, 240);
    mode_param(blacker, .35);
    mode_param(fillin, -.2);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;

% From rocky@panix.com. For the typewriter, slanted, and italic
% fonts, blacker = 0 makes the 'M's and 'W's more legible. But then
```

```
% the weight of the font does not match the others.
mode_def ibmd =                                          % IBM 38xx (240dpi)
    mode_param(pixels_per_inch, 240);
    mode_param(blacker, .3);
    mode_param(fillin, .4);
    mode_param(o_correction, .75);
    mode_common_setup_;
enddef;

% These values from melvin@math.psu.edu.
mode_def ibmega =                                        % IBM EGA monitor (96x81dpi)
    mode_param(pixels_per_inch, 96);
    mode_param(aspect_ratio, .841);
    mode_param(blacker, .3);
    mode_param(fillin, 0);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;

mode_def ibmegal =                                       % IBM EGA monitor landscape (81x96dpi)
    ibmega_;
    landscape;
enddef;

% From sperber@provence.informatik.uni-tuebingen.de, 30 October 1993.
% The difference of 0.1 in blacker really does make a difference.
mode_def ibmfzon =                                       % IBM 4019 (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .1);
    mode_param(fillin, 0);
    mode_param(o_correction, .75);
    mode_param(blacker_min, 2);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
IBMFourZeroOneNine := ibmfzon;

% From rocky@panix.com. The print engine is made by Lexmark. The
% printing person I asked, Paul Dantzig, says that the print quality of
% the 4019 is fairly regular. Unlike the IBM 4216's, to his knowledge
% only there is only one print engine by Lexmark has been ever used in
% the 4019. And unlike the IBM 4029, there are not knobs on the inside
% that would permit one to adjust the blacker to ones taste.
%
% While both RicohA and cx modes settings are acceptable, it looks
% to me that the RicohA fonts are superior. I base this judgement on
% tops and bottoms of curves on cmr10 such as 'S', 'U' 'e' 'o' and
% the apostrophes. This effect is especially noticeable in a small font
% like cmr6.
%
% If you want to experiment with another setting, I'd start with RicohA
% and set blacker to .1 or 0 instead of .2 but definitely keep
% mode_write_white_setup_; I'd leave fillin and o_correction unchanged.
%
% From vumalki%weizmann.weizmann.ac.il@taunivm.tau.ac.il
```

```
% and plotkin@theory.stanford.edu.
%
% hafner@almaden.ibm.com (Jim Hafner) reports that this works fine
% for the Lexmark 4039, a.k.a. IBM 4039, as along as the "Printer
% Darkness" control is set to "darker".
%
mode_def ibmfztn =                                  % IBM 4029-30-39, 4250 (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, .05);
    mode_param(fillin, 0);
    mode_param(o_correction, .75);
    mode_common_setup_;
enddef;
IBMFourZeroTwoNine := ibmfztn;
IBMFourTwoThreeZero := ibmfztn;
IBMFourTwoFiveZero := ibmfztn;
IBMFourZeroThreeNine := ibmfztn;
LexmarkFourZeroThreeNine := ibmfztn;

% From Rick Simpson via erikjan@icce.rug.nl.
mode_def ibmpp =                                    % IBM ProPrinter (240x216dpi)
    mode_param(pixels_per_inch, 240);
    mode_param(aspect_ratio, 216/pixels_per_inch);
    mode_param(blacker, 0);
    mode_param(fillin, .2);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
IBMProPrinter := ibmpp;
proprinter := IBMProPrinter;

mode_def ibmppl =                                   % IBM ProPrinter (216x240dpi)
    ibmpp_;
    landscape;
enddef;

% From Rick Simpson via erikjan@icce.rug.nl. Also gave values
% of zero for blacker, fillin, and o_correction.
mode_def ibmsoff =                                  % IBM 6154 display (118dpi)
    mode_param(pixels_per_inch, 118);
    mode_param(blacker, .8);
    mode_param(fillin, .2);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
IBMSixOneFiveFour := ibmsoff;

% From rocky@panix.com. This is an old, untested definition.
mode_def sherpa =                                   % IBM 6670 (Sherpa) (240dpi)
    mode_param(pixels_per_inch, 240);
    mode_param(blacker, 1);
    mode_param(blacker_min, 2);
    mode_param(fillin, 1);
    mode_param(o_correction, .5);
    mode_common_setup_;
```

```
    mode_write_white_setup_;
enddef;
IBMSixSixSevenZero := sherpa;

% From vumalki%weizmann.weizmann.ac.il@taunivm.tau.ac.il.
mode_def ibmteot =                                          % IBM 3812 (240dpi)
    mode_param(pixels_per_inch, 240);
    mode_param(blacker, .6);
    mode_param(blacker_min, 2);
    mode_param(fillin, .4);
    mode_param(o_correction, 0);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
IBMThreeEightOneTwo := ibmteot;
IBMUlfHolleberg := IBMThreeEightOneTwo;

% These values from d_webb@chcc.harwell.aea-technology.uk.
mode_def ibmtetz =                                          % IBM 3820 (240dpi)
    mode_param(pixels_per_inch, 240);
    mode_param(blacker, .78);
    mode_param(fillin, .25);
    mode_param(o_correction, .5);
    mode_common_setup_;
enddef;
IBMThreeEightTwoZero := ibmtetz;

% From x92@vm.urz-uni-heidelberg.de via schoepf@sc.zib-berlin.de.
mode_def ibmtont =                                          % IBM 3193 screen (100dpi)
    mode_param(pixels_per_inch, 100);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;
IBMThreeOneNineThree := ibmtont;

% From x92@vm.urz-uni-heidelberg.de via schoepf@sc.zib-berlin.de.
mode_def ibmtosn =                                          % IBM 3179 screen (87x65dpi)
    mode_param(pixels_per_inch, 87);
    mode_param(aspect_ratio, 0.75);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;
IBMThreeOneSevenNine := ibmtosn;

mode_def ibmtosnl =                                         % IBM 3179 screen landscape (65x87dpi)
    ibmtosn_;
    landscape;
enddef;

% These values from d_webb@chcc.harwell.aea-technology.uk.
% melvin@math.psu.edu thinks pixels_per_inch = 96 might be better.
mode_def ibmvga =                                           % IBM VGA monitor (110dpi)
```

```
    mode_param(pixels_per_inch, 110);
    mode_param(blacker, .3);
    mode_param(fillin, 0);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;

% The Chelgraph IBX is the machine introduced to North American TeX
% users by Type 2000 in Mill Valley, California; telephone (415) 388-8873.
% Since the machine's stated output resolution is only 2000 dpi
% this truly spectacular 9600 dpi must be used for translation to
% an outline font description. This has been tested and used in a
% publication of the University of Washington Press. These values
% from Pierre MacKay, based on Lance Carnes' crs values, at magstep 1.8.
mode_def ibx =                                          % Chelgraph IBX (9600dpi)
    mode_param(pixels_per_inch, 4000 + 4000 + 1600);
    mode_param(blacker, 4);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
ChelgraphIBX := ibx;

% From local.mf via cudat@cu.warwick.ac.uk.
mode_def itoh =                                         % CItoh 8510A (160x144dpi)
    mode_param(pixels_per_inch, 160);
    mode_param(aspect_ratio, 144/pixels_per_inch);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .1);
    mode_common_setup_;
enddef;
CItohEightFiveOneZero := itoh;

mode_def itohl =                                        % CItoh 8510A landscape (144x160dpi)
    itoh_;
    landscape;
enddef;

% From rokicki@cs.umb.edu.
mode_def itohtoz =                                      % CItoh 310 (240x144dpi)
    mode_param(pixels_per_inch, 240);
    mode_param(aspect_ratio, 144/pixels_per_inch);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;
citohtoz := itohtoz;
CItohThreeOneZero := itohtoz;
cthreeten := itohtoz;

mode_def itohtozl =                                     % CItoh 310 landscape (144x240dpi)
    itohtoz_;
    landscape;
enddef;
```

```
% Perhaps the value for fillin should be 0.
mode_def iw =                                          % Apple ImageWriter (144dpi)
    mode_param(pixels_per_inch, 144);
    mode_param(blacker, 0);
    mode_param(fillin, 0.3);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;
imagewriter := iw;

% From stsmith@ll.mit.edu, 20 August 93.
% The mode cx is too spindly.
mode_def jetiiisi =                                    % HP Laser Jet IIISi (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .2);
    mode_param(fillin, 0);
    mode_param(o_correction, .7);
    mode_common_setup_;
enddef;
HPLaserJetIIISi := jetiiisi;

% From John Sauter.
mode_def lasf =                                        % DEC LA75 (144dpi)
    mode_param(pixels_per_inch, 144);
    mode_param(blacker, .3);
    mode_param(fillin, -.1);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;
LASevenFive := lasf;

% Michael Covington's (mcovingt@ai.uga.edu) definition for the
% Lexmark Optra R (4049), reflecting a taste for a heavier than
% normal rendition of the Computer Modern fonts.
%
% You may prefer a lesser value of blacker (down to maybe 1.0).
% Initially tested on 10, 12, 17-point CMR and 10-point math italic.
%
% While we're talking about the Optra R, here's another useful fact:
% it takes 32-bit-wide 72-pin SIMMs, 70 or 80 ns. Contrary to the
% documentation, you do not have to use IBM's special SIMMs.
%
% The resolution of 1200 and the blacker value of 3 causes cmbsy7
% to be generated with incorrect arrows and radical sign. The
% vtftzzlo mode also fails. Decreasing blacker to 2 works around.
% From infovore@xs4all.nl (Olaf Weber) and Henrik Schmiediche.
%
mode_def lexmarkr =                                    % Lexmark Optra R 4049 (1200dpi)
    mode_param(pixels_per_inch, 1200);
    mode_param(blacker, 2); % used to be 3; works around cmbsy7 bug
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
LexmarkOptraR := lexmarkr;
```

```
% Klaus Guntermann <guntermann@iti.informatik.tu-darmstadt.de>.
% 19 January 1998. Mode for a Lexmark Optra S laser printer in true
% 1200dpi mode. This printer model seems to be the successor of the
% Optra R series above.
%
mode_def lexmarks =                                   % Lexmark Optra S 1250/1650/2450 (1200dpi)
    mode_param(pixels_per_inch, 1200);
    mode_param(blacker, 1);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
LexmarkOptraS := lexmarks;

% uri@watson.ibm.com (Uri Blumenthal), 9 March 1997.
% This is really a 1200 dpi printer, but it can be operated in 600dpi mode.
mode_def lexmarku =                                   % Lexmark Optra R+ 4049 (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, .5);
    mode_param(fillin, 0);
    mode_param(o_correction, .75);
    mode_param(tracingtitles, 0);
    mode_common_setup_;
enddef;

mode_def linolo =                                     % Linotype Linotronic [13]00 (635dpi)
    mode_param(pixels_per_inch, 635);
    linoone_;
enddef;
LinotypeOneZeroZeroLo := linolo;
linohalf := LinotypeOneZeroZeroLo;

% Mode for Linotype Linotronic L-330 with a RIP-50 raster.
% From: Steven T. Smith stsmith@ll.mit.edu, 26 October 95.
mode_def linolttz =                                   % Linotronic L-300 with RIP-50 (3386dpi)
    mode_param(pixels_per_inch, 3386);
    mode_param(blacker, 0);
    mode_param(o_correction, 1);
    mode_param(fillin, 0);
    mode_common_setup_;
enddef;
LinotypeLThreeThreeZero := linolttz;

% These values from d_webb@chcc.harwell.aea-technology.uk.
% The 'a' in cmr5 looks better with blacker = .3. Values of .2
% for both blacker and fillin have also been used.
mode_def linoone =                                    % Linotronic [13]00 (1270dpi)
    mode_param(pixels_per_inch, 1270);
    mode_param(blacker, .65);
    mode_param(o_correction, 1);
    mode_param(fillin, -.1);
    mode_common_setup_;
enddef;
LinotypeOneZeroZero := linoone;
linohi := LinotypeOneZeroZero;
```

```
linothreelo := LinotypeOneZeroZero;

% These values from d_webb@chcc.harwell.aea-technology.uk.
mode_def linotzzh =                                   % Linotype Linotronic 300 (2540dpi)
    mode_param(pixels_per_inch, 2540);
    mode_param(blacker, .2); % Copied from aps—conjectural.
    mode_param(fillin, .2); % (ditto)
    mode_param(o_correction, 1); % (ditto)
    mode_common_setup_;
enddef;
linothree := linotzzh;
LinotypeThreeZeroZeroHi := linotzzh;
linosuper := linotzzh;

% (From Matt Swift swift@alum.mit.edu, 1 Jan 1996.) This is a mode for
% the HP LaserJet 5P, using dvipsk-5.58f and gs-2.6.2. I tuned it using
% the file modetest.tex. The first sweep was (b,f,o) = (0, 0, .3, .6,
% 0). The diagonal of 10 pt lowercase z was too thin at .6, too thick
% at 0. The second sweep was (.4, .5, .6, .7, .3, 0). At .6, the 5 pt
% small-cap lower-case A was on the verge of being filled in, but .6 is
% a reasonable value. Blacker .4 looked a little spindly for many of
% the 5 pt fonts, especially italic and small-cap. The next sweep was
% (.5, .3, 0, .4, .7, 1). The sides of the 14 pt upper-case O
% (especially roman and small-cap) are relatively fatter with
% o-correction 0 as opposed to 1. Almost every other mode for 600 dpi
% printers has 1, so I'm going with that.
%
mode_def ljfive =                                     % HP LaserJet 5 (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, .75);
    mode_param(fillin, .3);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
laserjetfive := ljfive;

% From Michael Neuhauser neuhauser@eiunix.tuwien.ac.at. This is a
% mode for HP LaserJet 5MP. I started with ljfive and found the Computer
% Modern fonts much too black. Therefore I experimented with different
% values of blacker to find .4 to be best.
mode_def ljfivemp =                                   % HP LaserJet 5MP (600 dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, .4);
    mode_param(fillin, .3);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
laserjetfivemp := ljfivemp;
% There have been many modes for the LaserJet 4. The current values were
% found by kb@tug.org to be reasonable on a LaserJet 4MP
% (at the default density setting, with resolution enhancement enabled).
% I don't intend to change them again (unless someone convinces me
% that they are truly mistaken in some way), although I would consider adding
% different modes for other LaserJet 4 printers, if people contribute them.
%
```

```
% (cthiele@ccs.carleton.ca gets better results with the density
% setting on the printer at 4, instead of 3.)
%
% The first LaserJet 4 mode came from tonnie@ctrl.phys.tue.nl,
% 13 January 1993, with blacker = 0, fillin = 0, and o_correction = .6.
% (This definition was forwarded to me by Barbara Beeton, and was
% intended to be preliminary.)
%
% fj@iesd.auc.dk says that IBMFourZeroTwoNine works fine.
%
% mbr@research.nj.nec.com supplied another set of values:
% blacker = .6, fillin = 0, and o_correction = 1. He writes:
% I've tested it extensively at 10 pt and 12 pt in both roman, italic,
% and bold, and I've checked all the standard smaller sizes (5, 6, 7, 8,
% and 9 pt). Works reasonably well on both the LaserJet 4 and the 4si,
% although characters come out somewhat lighter on the 4si. Assumes
% that the density controls are set to their default values and that the
% resolution enhancement feature is enabled. The blacker value was
% chosen to make 12 pt text look good; for 10 pt text, set blacker = .66.
%
% I felt the output with blacker = .6 was too dark; Computer Modern
% was never intended to be as dark as it appears on 300 dpi printers.
% So I've decreased blacker to the value below. The other parameters
% don't seem to matter much. (Even blacker doesn't matter all
% that much.)
%
% Works for a 600 dpi Accel-a-Writer mackay@cs.washington.edu,
% 16 August 95.
%
% Possibly also usable for the LaserJet 6 family.
% From chj@lin.foa.se (Christian Jvnsson), 29 January 1997.
%
mode_def ljfour =                                   % HP LaserJet 4 (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, .25);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
laserjetfour := ljfour;
% fn@junior.mathtok.polymtl.ca uses this for the QMS-860.
qmsesz := ljfour;
% pete@lovelace.thi.informatik.uni-frankfurt.de uses this for the
% Apple LaserWriter Select 360, with a Fuji Xerox Xerographic engine.
aselect := ljfour;

% jrenkema@worldonline.nl, 2 January 1998. The LaserJet 5M
% mode_def, blacker = .35, had very light output on the 4000. The
% blacker = 2 setting results in output comparable to the LaserJet 5M
% with blacker = .35. It is also noteworthy that in the ProRes 1200 mode
% HP's resolution enhancement technology (RET) is not used, thus output
% is exactly according to METAFONT. But perhaps blacker = 2 is too much, as
% Computer Modern is supposed to be pretty light.
mode_def ljfzzz =                                   % LaserJet 4000N, ProRes mode (1200dpi)
```

```
    mode_param(pixels_per_inch, 1200);
    mode_param(blacker, 1);
    mode_param(fillin, .1);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
laserjetfourzerozerozero := ljfzzz;
laserjetfourthousand := ljfzzz;

% Nicolai Langfeldt <janl@math.uio.no>, 16 May 1998.
% This is for the default 16ppm 600dpi mode.
%
mode_def ljfzzzfr =                                   % HP LaserJet 4000 FastRes (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, 0);
    mode_param(fillin, .2);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;

% From ST-TeX.MF via braams@pttrnl.nl. (The 300dpi LaserJet
% is another cx.)
mode_def ljlo =                                       % HP LaserJet (150dpi)
    mode_param(pixels_per_inch, 150);
    mode_param(blacker, 0);
    mode_param(fillin, .1);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
laserjetlo := ljlo;

% Niko Sauer <nikos@friedrichs.up.ac.za>, 11 October 2000.
% Here are modes developed for and tested on the HP LaserJet 2100T/TN.
% Mode ljtozz is for a resolution of 1200dpi, and ljtozzfr for 600dpi
% Tradeoffs between fillin and blacker resulted in very clear,
% sharp renderings of Computer Modern fonts which appears to be
% preferable to what the modes ljfzzz ljfzzzfr for HP LaserJet 4000
% yield on this printer. Preferences were tested by scrutiny of the
% results by sample of people in the vicinity.
%
mode_def ljtozz =                                     % HP LaserJet 2100T/TN (1200dpi)
    mode_param(pixels_per_inch, 1200);
    mode_param(blacker, .7);
    mode_param(fillin, .15);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
laserjettwoonezerozero := ljtozz;
%
mode_def ljtozzfr =                                   % HP LaserJet 2100T/TN (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, .25);
    mode_param(fillin, .3);
    mode_param(o_correction, 1);
    mode_common_setup_;
```

```
enddef;
laserjettwoonezerozerofastres := ljtozzfr;

% From mackay@cs.washington.edu, 13 January 1993. The actual
% machine resolution of this machine is 1000 × 400, but it is
% adjusted with the aid of software so that a 1000 × 1000 PK file
% is used. The o_correction, however, seems grossly overdone if
% the expected value of at or near unity is applied (on the grounds
% that a 1000 dpi font should be able to do full o-correction).
% Apparently the 400 dpi physical resolution has some effect here.
% In any case, o_correction = 0.4 looks better, and lines up with
% about the right optical adjustment on curves. Tested at American
% School of Classical Studies Publications on 18 July, 1992.
mode_def lmaster =                                   % LaserMaster (1000dpi)
    mode_param(pixels_per_inch, 1000);
    mode_param(blacker, 0.2);
    mode_param(fillin, 0.0);
    mode_param(o_correction, 0.4);
    mode_common_setup_;
enddef;
lasermaster := lmaster;

% From fran@hexamon.demon.co.uk, 10 March 1996. I tried the entry
% in modes.mf for a DEC LN03. This turned out much too dark—everything
% looks bold. I did try sending write-black fonts to this printer, the
% hairlines disappear. I don't know if these printers have a
% blackness knob . . .
mode_def lnotr =                                     % DEC LN03R Scriptprinter (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, 0);
    mode_param(blacker_min, 2);
    mode_param(fillin, -.6);
    mode_param(o_correction, .5);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
LNOthreR := lnotr;

% From Richard Watson at the Queensland Institute of Technology. This
% printer is said to have some kind of Xerox engine, but I don't know which.
mode_def lnzo =                                      % DEC LN01 (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .9);
    mode_param(blacker_min, 2);
    mode_param(fillin, 0);
    mode_param(o_correction, .5);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
LNZeroOne := lnzo;
lps := lnzo;
LPSFourZero := lnzo;

% From hammond@jila.Colorado.EDU, 21 January 1993. Modified from
% qms. Prints exactly like the QMS fonts from Northlake Software.
```

```
mode_def lpstz =                                        % DEC lps20 (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .6);
    mode_param(fillin, −.3);
    mode_param(o_correction, .6);
    mode_common_setup_;
enddef;
LPSTwoZero := lpstz;

mode_def lqlores =                                      % Epson LQ-500 (180dpi)
    mode_param(pixels_per_inch, 180);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .1);
    mode_common_setup_;
enddef;
EpsonLQFiveZeroZeroLo := lqlores;

% This and EpsonLQFiveZeroZeroLo also work for a Mannesmann 300
% (from cudat@csv.warwick.ac.uk, 4 September 1991). The 360 × 360
% modes for these printers fails for cudat, however.
mode_def lqmed =                                        % Epson LQ-500 (360x180dpi)
    mode_param(pixels_per_inch, 360);
    mode_param(aspect_ratio, 180/pixels_per_inch);
    mode_param(blacker, 0); % 0.3 avoids 'holes'.
    mode_param(fillin, 0);
    mode_param(o_correction, .1);
    mode_common_setup_;
enddef;
lqmedres := lqmed;
EpsonLQFiveZeroZeroMed := lqmed;

mode_def lqmedl =                                       % Epson LQ-500 landscape (180x360dpi)
    lqmed_;
    landscape;
enddef;

% These values from karl@cs.umb.edu. blacker = .8 or more
% thickens dots, to their detriment. blacker = .6 produces two-pixel
% stems, which looks pretty good for cmr, but it's a little dark
% for cmti, and cmbx and cmr then turn out the same.
% o_correction = 1 made no difference. fillin = 1 made no
% difference.
mode_def lview =                                        % Sigma L-View monitor (118x109dpi)
    mode_param(pixels_per_inch, 118.06);
    mode_param(aspect_ratio, 109.25/pixels_per_inch);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;

mode_def lviewl =                                       % Sigma L-View monitor landscape (109x118dpi)
    lview_;
    landscape;
enddef;
```

```
% From Pierre.Soille@ipk.fhg.de, 13 February 1995.
% This printer also runs at 300 dpi (try cx), 400 dpi (next),
% and 600 dpi (ljfour).
mode_def lwpro =                                    % Apple LaserWriterPro 810 (800dpi)
    mode_param(pixels_per_inch, 800);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;

% This is untested.
mode_def macmag =                                   % Mac screens at magstep 1 (86dpi)
    mode_param(pixels_per_inch, 86.4);
    mode_param(blacker, .35);
    mode_param(fillin, .1);
    mode_param(o_correction, .3);
    mode_common_setup_;
enddef;

% From the VMS distribution tape (except karl@cs.umb.edu changed
% the o_correction to zero).
mode_def mactrue =                                  % Mac screen (72dpi)
    mode_param(pixels_per_inch, 72);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;
MacTrueSize := mactrue;

% From mcgrant@rascals.stanford.edu, 17 December 1992.
% Various other values made little difference.
mode_def ncd =                                      % NCD 19-inch (95dpi)
    mode_param(pixels_per_inch, 95);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;

% From rokicki@neon.stanford.edu.
mode_def nec =                                      % NEC (180dpi)
    mode_param(pixels_per_inch, 180);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;

% This is the same as cx, except for the resolution.
mode_def nechi =                                    % NEC-P6 (360dpi)
    mode_param(pixels_per_inch, 360);
    cx_;
enddef;
lqhires := nechi;
```

```
% fkr@tooyoo1.l.u-tokyo.ac.jp, 7 June 1995.
mode_def neclm =                                        % NEC PC-PR406LM (320dpi)
    mode_param(pixels_per_inch, 320);
    mode_param(blacker, .1);
    mode_param(fillin, 0);
    mode_param(o_correction, .6);
    mode_common_setup_;
enddef;

% fkr@tooyoo1.l.u-tokyo.ac.jp, 7 June 1995.
mode_def nectzo =                                       % NEC PC-PR201 series (160dpi)
    mode_param(pixels_per_inch, 160);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;
NecTwoZeroOne := nectzo;

% From rokicki@neon.stanford.edu.
mode_def nexthi =                                       % NeXT Newgen (400dpi)
    mode_param(pixels_per_inch, 400);
    cx_;
enddef;
NeXTprinter := nexthi;
Newgen := nexthi; % From lambert@silver.cs.umanitoba.ca.

% From rokicki@neon.stanford.edu.
mode_def nextscrn =                                     % NeXT monitor (100dpi)
    mode_param(pixels_per_inch, 100);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;
NeXTscreen := nextscrn;
nextscreen := nextscrn;

% ghibo@galileo.polito.it, for the Amiga ShowDVI previewer.
mode_def nineone =                                      % NineOne (91x91) (91dpi)
  mode_param(pixels_per_inch, 91);
  mode_param(blacker, 0);
  mode_param(fillin, 0);
  mode_param(o_correction, .2);
  mode_common_setup_;
enddef;
NineOne := nineone;

% From jbotz@mtholyoke.edu, 21 April 1993.
% Make TFM files only.
mode_def nullmode =                                     % TFM files only (101dpi)
    % The resolution is irrelevant, but METAFONT always ships out
    % characters, so don't use the default huge proof resolution.
    mode_param(pixels_per_inch, 101);
    mode_param(proofing, -1);
    mode_param(fontmaking, 1);
```

```
enddef;

% ghibo@galileo.polito.it, for the Amiga ShowDVI previewer.
mode_def onetz =                                        % OneTwoZero (120/120) (120dpi)
  mode_param(pixels_per_inch, 120);
  mode_param(blacker, 0);
  mode_param(fillin, 0);
  mode_param(o_correction, .2);
  mode_common_setup_;
enddef;
OneTwoZero := onetz;

% From deby@cs.utwente.nl and issue@vax.oxford.ac.uk.
mode_def ocessfz =                                      % OCE 6750-PS (508dpi)
    mode_param(pixels_per_inch, 508);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .7);
    mode_common_setup_;
enddef;
OCESixSevenFiveZeroPS := ocessfz;

% From rokicki@neon.stanford.edu.
mode_def okidata =                                      % Okidata (240x288dpi)
    mode_param(pixels_per_inch, 240);
    mode_param(aspect_ratio, 288/pixels_per_inch);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;
okihi := okidata;

mode_def okidatal =                                     % Okidata landscape (288x240dpi)
    okidata_;
    landscape;
enddef;

% roussel@henri.chem.uleth.ca. For the dark smoothing mode.
mode_def okifte =                                       % Okidata 410e in 600DPI mode (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, .6);
    mode_param(fillin, .1);
    mode_param(o_correction, .85);
    mode_common_setup_;
enddef;
okifourten := okifte;

% From AMSmodes.def.
mode_def pcscreen =                                     % also, e.g., high-resolution Suns (118dpi)
    mode_param(pixels_per_inch, 118);
    mode_param(blacker, .5);
    mode_param(fillin, .1);
    mode_param(o_correction, .3);
    mode_common_setup_;
enddef;
```

```
% fkr@tooyoo1.l.u-tokyo.ac.jp, 7 June 1995. With the existing
% bitgraph and pcscreen modes, 'm' looks bad: a long vertical
% line extends higher than the letter itself.
mode_def pcprevw =                                  % PC screen preview (118dpi)
    mode_param(pixels_per_inch, 118);
    mode_param(blacker, .2);
    mode_param(fillin, 0);
    mode_param(o_correction, .2);
    mode_common_setup_;
enddef;

% Tektronix Color PostScript printer, from craig@sunspot@noao.edu
% on 14 January 1993. He writes: This is a thermal wax paper printer.
% The values were determined using the cmr10 and cmti10 fonts.
% The generated fonts look reasonable, although vertical lines and
% things like the [, ], and / characters are pretty thin.
mode_def phaser =                                   % Tektronix Phaser PXi (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, 1.1);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;

% From metod.kozelj@rzs-hm.si (Metod Kozelj), 30 July 1998.
% Parameters other than blacker have little effect.
mode_def phaserfs =                                 % Tektronix Phaser 560 (1200dpi)
    mode_param(pixels_per_inch, 1200);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
phaserfivesixzero := phaserfs;

% Tektronix Phaser 350 is a 600-by-300 colour wax printer.
% From dag@ifi.uio.no (Dag Langmyhr), 10 January 1997.
% Perhaps too fat at small sizes (5 pt) but looks OK for 8 pt and more.
mode_def phasertf =                                 % Tektronix Phaser 350 (600x300dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(aspect_ratio, 300/pixels_per_inch);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .6);
    mode_common_setup_;
enddef;

mode_def phasertl =                                 % Tektronix Phaser 350 landscape (300x600)
    phasertf_;
    landscape;
enddef;
phasertfl := phasertl;

% From Aries Arditi <aries@play.lighthouse.org>, 3 February 1998.
% This definition makes one pixel one point, which is convenient when
% you want to image-process the letter images after rendering, and don't
```

```
% want to add any device corrections. If you want to grab the images off
% the screen, it's useful to add lines to the definition, as well:
%
%   mode_param(proofing, 1);
%   extra_endchar:=extra_endchar&"showit";
%   extra_setup := extra_setup&"def openit = openwindow currentwindow from
%     origin to (screen_rows,screen_cols) at (0,50) enddef";
mode_def pixpt =                                        % one pixel per point (72.27dpi)
    mode_param(pixels_per_inch, 72.27);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;

% For Hans Hagen and Mikael Sundqvist's use of bitmaps, December 2023.
mode_def potrace =                                      % potrace use in LMTX
          mode_param(pixels_per_inch, 2 * 3600);
          mode_param(blacker, 0);
          mode_param(fillin, 0);
          mode_param(o_correction, 1);
          mode_common_setup_;
enddef;

% This is a write-white PostScript laser-setter, made by a Xerox
% subsidiary. Its true aspect ratio is 1200 dpi horizontally and
% 600 dpi vertically, but mis@apsedoff.bitnet says that the
% printer hides this, and PostScript programs should treat it as having
% a square aspect ratio. But george@trevnx.bio.dfo.ca says that
% using the nonsquare aspect ratio produces identical output and uses
% only half the disk space. He also says the fonts are much too dark
% in general, and produce invisible diagonals in the CM typewriter
% fonts—but other changes either produce errors or dark output.
%
% Printware's headquarters is in Minnesota; telephone (612) 456-1400.
mode_def prntware =                                     % Printware 720IQ (1200dpi)
    mode_param(pixels_per_inch, 1200);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
PrintwareSevenTwoZeroIQ := prntware;
printware := prntware;

% From John Gourlay. See TUGboat 8(2), page 133.
mode_def qms =                                          % QMS (Xerox engine) (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .6);
    mode_param(blacker_min, 2);
    mode_param(fillin, -.3);
    mode_param(o_correction, .6);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
```

```
% From Boris.Hemkemeier@HRZ.Uni-Bielefeld.De, 24 June 1993.
% With the QMSOneSevenZeroZero mode, the left stem of 'M'
% in cmr10 vanishes completely.
mode_def qmsostf =                                          % QMS 1725 (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, 1);
    mode_param(blacker_min, 2);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
QMSOneSevenTwoFive := qmsostf;

% From queinnec@geant.cenatls.cena.dgac.fr, 24 March 1993.
% k316670@aearn.bitnet says this print has a CanonNX engine
% switchable between 300 and 600 dpi.
%
% From mimi@scri.fsu.edu (Mimi Burbank), 12 September 1996:
% . . . When I found the note about the left stem of the 'M'
% disappearing I was concerned.
%
% The error, I believe, is due to the fact that the font is generated at
% 600 dpi, and was most likely printed on a QMS printer with 300 dpi
% resolution. I just had the same thing happen to me, but with our QMS
% 860 set at 600dpi (the default for only one of our printers) the
% output was beautiful! (I printed the same ps file on a QMS 2000 with
% 300 dpi resolution, and on a QMS 860 with 600 dpi resolution.)
mode_def qmsoszz =                                          % QMS 1700 (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, .2);
    mode_param(blacker_min, 2);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
QMSOneSevenZeroZero := qmsoszz;

% From teddy@fukt.hk-r.se, 28 September 1996.
mode_def qmstftf =                                          % QMS 2425 (1200dpi)
    mode_param(pixels_per_inch, 1200);
    mode_param(blacker, .3);
    mode_param(fillin, .5);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
QMSTwoFourTwoFive := qmstftf;

% These values from Stan Osborne, TUGboat 8(2), page 134.
mode_def ricoh =                                            % e.g., TI Omnilaser (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .2);
    mode_param(blacker_min, 2);
    mode_param(fillin, -.2);
```

```
    mode_param(o_correction, .5);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
RicohFourZeroEightZero := ricoh;
RicohFortyEighty := ricoh;

% From Martin.Ward@durham.ac.uk. Apparently the engine is
% different from the Ricoh 4080. With a larger value of blacker,
% characters like the 'e' in cmtt8 look bad.
mode_def ricoha =                                   % e.g., IBM 4216 (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .2);
    mode_param(blacker_min, 2);
    mode_param(fillin, 0);
    mode_param(o_correction, .75);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
RicohA := ricoha;
IBMFourTwoOneSix := ricoha;

% From John Sauter.
mode_def ricohlp =                                  % e.g., DEC LN03 (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .65);
    mode_param(blacker_min, 2);
    mode_param(fillin, -.2);
    mode_param(o_correction, .5);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
RicohLP := ricohlp;
LNOthree := ricohlp;
LNZeroThree := ricohlp;

% From nishida@src.ricoh.co.jp (Akihiro Nishida), 30 August 1996.
% These printers are available only in Japan.
mode_def ricohsp =                                  % Ricoh sp10ps/lp7200-ux (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, 0);
    mode_param(fillin, 0.2);
    mode_param(o_correction, .6);
    mode_common_setup_;
enddef;

% From dickson@eeserv.ee.umanitoba.ca. gil.cc.gatech.edu
% has different values; img@ai.edinburgh.ac.uk sets blacker = .1.
% Corrected by andy@vlsi.cs.caltech.edu, 28 August 1991.
% The darkness knob on the printer has a much larger effect than
% any of these parameters. carlos@snfep1.if.usp.br points out
% that the printer can operate at either 300 dpi or 400 dpi, and
% if your fonts don't match the setting, naturally they won't look
% very good. He says the following works in Dvips' config.ps file
% to set 400 dpi:
```

```
% /SetResolution {
%     /setres where {
%         /setres get exec
%     }{
%         pop
%     } ifelse
% } def
% %%BeginFeature *SetResolution 400
% 400 SetResolution
% %%EndFeature
% %%EndSetup
%
% (This is the file resolution400.ps supplied with NeWSprint.)
% simpson@math.psu.edu only got this work by downloading the code
% via an extra header file, i.e., having this in the Dvips config file:
% M sparcptr
% D 400
% h resolution400.ps
%
mode_def sparcptr =                                   % Sun SPARCprinter (400dpi)
    mode_param(pixels_per_inch, 400);
    mode_param(blacker, .25);
    mode_param(fillin, .2);
    mode_param(o_correction, .6);
    mode_common_setup_;
enddef;
SparcPrinter := sparcptr;

% From ee@dacth51.bitnet.
mode_def starnlt =                                    % Star NL-10 (240x216dpi)
    mode_param(pixels_per_inch, 240);
    mode_param(aspect_ratio, 216/pixels_per_inch);
    mode_param(blacker, 0);
    mode_param(fillin, .2);
    mode_param(o_correction, .4);
    mode_common_setup_;
enddef;
StarNLOneZero := starnlt;

mode_def starnltl =                                   % Star NL-10 landscape (216x240dpi)
    starnlt_;
    landscape;
enddef;

% From alejolo@sue.ideam.gov.co, 26 November 1998. I have tested
% the default stylewriter mode in modes.mf v3.4 with OzTeX and my
% StyleWriter II, and still output is too light, particularly the serifs
% and thin cusps such as in CMR's small e, c, t, b and d. Thus I cooked
% up this mode that prints output similar to a standard system font (I
% compared text output with Minion Web as it comes with Internet
% Explorer 4). In general I'd suggest that this mode definition is
% appropriate for all inkjet printers using a BJC-02 ink cartridge.
mode_def styletwo =                                   % Apple StyleWriter II (360dpi)
    mode_param(pixels_per_inch, 360);
    mode_param(blacker, 0.25);
```

```
    mode_param(fillin, 0);
    mode_param(o_correction, 0.6);
    mode_common_setup_;
enddef;
swtwo := styletwo;

% stylewriter mode added by Andrew Trevorrow
% <akt@netspace.net.au> for OzTeX users. All
% parameters (except pixels_per_inch) are the same as the cx mode so
% that PK files can be shared by both types of printers.
%
% With blacker = 0, hbar is indistinguishable for h, i.e., the bar
% disappears. Thus 0.1. From Wulf Hofbauer <wh@echo.chem.TU-Berlin.DE>,
% 5 June 1998.
mode_def stylewri =                                   % Apple StyleWriter (360dpi)
    mode_param(pixels_per_inch, 360);
    mode_param(blacker, 0.1);
    mode_param(fillin, .2);
    mode_param(o_correction, .6);
    mode_common_setup_;
enddef;
stylewriter := stylewri;
stylewr := stylewri;
% From px@fct.unl.pt (Joaquim Baptista [pxQuim]). I find
% epstylus far too dark. It seems to me that plain values of 0 to
% blacker and fillin work perfectly with values of o_correction in
% the range of .6 to .8. I ended up using [this mode:]
epstylwr := stylewri;
% Andrew defines sw as well, but I am reluctant to use such a
% potentially common identifier –kb@cs.umb.edu, 8 October 1996.

% From grunwald@foobar.colorado.edu. Sun monitors have several
% different resolutions, but this seems the most common of the lot.
% Use pcscreen for high-resolution monitors.
mode_def sun =                                        % Sun and BBN Bitgraph (85dpi)
    mode_param(pixels_per_inch, 85);
    mode_param(blacker, .35);
    mode_param(fillin, .1);
    mode_param(o_correction, .3);
    mode_common_setup_;
enddef;

mode_def supre =                                      % Ultre*setter (2400dpi)
    mode_param(pixels_per_inch, 2400);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;

mode_def toshiba =                                    % Toshiba 13XX, EpsonLQ (180dpi)
    mode_param(pixels_per_inch, 180);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, .2);
```

```
    mode_common_setup_;
enddef;
epsonlq := toshiba;

mode_def ultre =                                        % Ultre*setter (1200dpi)
    mode_param(pixels_per_inch, 1200);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
Prism := ultre;

% From Martin.Ward@durham.ac.uk.
mode_def vs =                                           % VAXstation monitor (78dpi)
    mode_param(pixels_per_inch, 78);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 0);
    mode_common_setup_;
enddef;
VAXstation := vs;
gpx := vs;

% From erikjan@icce.rug.nl, 23 August 1991.
mode_def vtftzz =                                       % Varityper 4200 B-P (1800dpi)
    mode_param(pixels_per_inch, 1800);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
VarityperFourTwoZeroZero := vtftzz;

% From mjm@as.arizona.edu, 26 February 1992.
mode_def vtftzzhi =                                     % Varityper 4300P (2400dpi)
    mode_param(pixels_per_inch, 2400);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
VarityperFourThreeZeroZeroHi := vtftzzhi;

% From mjm@as.arizona.edu, 26 February 1992.
mode_def vtftzzlo =                                     % Varityper 4300P (1200dpi)
    mode_param(pixels_per_inch, 1200);
    mode_param(blacker, 2); % used to be 3.5, see lexmarkr comments.
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
VarityperFourThreeZeroZeroLo := vtftzzlo;

% From rocky@panix.com. This can also be used for the Autologic's
% APS6 cut sheet dry process printer. For that printer, perhaps
```

```
% blacker = 0.8 is better. For the Varityper, though, at blacker = 0.8
% the dots of the umlaut start to fill in. For blacker < 0.6, the tops
% and bottoms of lowercase g's and s's in cmr5 drop out.
mode_def vtfzszw =                                  % Varitype 5060W, APS 6 (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, .7);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
VarityperFiveZeroSixZeroW := vtfzszw;
APSSixMed := vtfzszw;

% The worst problem is toner irregularity. This may be the same printer
% as the IBM 4250.
mode_def vtszz =                                    % Varityper Laser 600 (600dpi)
    mode_param(pixels_per_inch, 600);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
VarityperSixZeroZero := vtszz;
VTSix := vtszz;
varityper := vtszz;

% Some information about Xerox printers, from siemsen@barnard.usc.edu:
% The Docutech system and the 4135 have the same engine.
% The 4050, 4075 and 4090 have the same engine.
% The 4650 has a unique engine.
% The 4850 has a unique engine.

% From SamuelKey@comcast.net, for enhanced resolution mode. In
% 600x600 mode, ljfour works ok.
mode_def xpstzz =                                   % Xerox Phaser 6200DP (2400x600dpi)
    mode_param(pixels_per_inch, 2400);
    mode_param(aspect_ratio, 600/pixels_per_inch);
    mode_param(blacker, 0);
    mode_param(fillin, 0);
    mode_param(o_correction, 1);
    mode_common_setup_;
enddef;
XeroxPhaserSixTwoZeroZeroDP := xpstzz;

mode_def xpstzzl =                                  % Xerox Phaser 6200DP landscape (600x2400dpi)
    xpstzz_;
    landscape;
enddef;

% From u12570@uicvm.uic.edu. These values are mostly guesses.
mode_def xrxesnz =                                  % Xerox 8790 or 4045 (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, 0.4);
    mode_param(blacker_min, 2);
    mode_param(fillin, 0);
```

```
    mode_param(o_correction, 0.2);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
XeroxEightSevenNineZero := xrxesnz;

% From u12570@uicvm.uic.edu. Many variations for different fonts.
% bart@cs.tamu.edu says this works for the Xerox 4700, also.
mode_def xrxfzfz =                                  % Xerox 4050/4075/4090/4700 (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .7);
    mode_param(fillin, 0);
    mode_param(o_correction, .5);
    mode_common_setup_;
enddef;
XeroxFourZeroFiveZero := xrxfzfz;

% From u12570@uicvm.uic.edu. He sent many variations of this,
% for different fonts. I don't know a reasonable way to put them in
% yet, so this is just the basic entry.
mode_def xrxnszz =                                  % Xerox 9700 (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .7);
    mode_param(fillin, 0);
    mode_param(o_correction, .5);
    mode_common_setup_;
enddef;
XeroxNineSevenZeroZero := xrxnszz;

% From lee@sq.com. These values may be improvable.
mode_def xrxtszz =                                  % Xerox 3700 (300dpi)
    mode_param(pixels_per_inch, 300);
    mode_param(blacker, .85);
    mode_param(blacker_min, 2);
    mode_param(fillin, -.1);
    mode_param(o_correction, .5);
    mode_common_setup_;
    mode_write_white_setup_;
enddef;
XeroxThreeSevenZeroZero := xrxtszz;

mode_def help =                                     % What modes are available?
  for i = 1 upto number_of_modes:
      message mode_name[i];
  endfor;
  % Doesn't make sense to be able to do this twice, so forget this
  % definition after it's been used.
  save?;
enddef;

let mode_help = help_;

% These variables determine the size of METAFONT's (window system)
% window for online output. These numbers should match whatever
% the window system is told, or bizarre positioning of the output
% in the window results. Properly implemented online device drivers
```

% will use these values as the default size. The defaults here are
% from `plain.mf`.
screen_rows := 400;
screen_cols := 500;

% The mode most commonly used to make fonts here.
localfont := *ljfour*;