H & L Associates' UPGUTILS
Mann Format Data Conversion Tool for
Mann/GCA Pattern Generators

User's Guide

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Mann Format Data Conversion Tools
for
GCA/Mann 1600A/2600/3000/3600 Pattern Generators

User's Guide

UPGUTILS-D0501

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Document Conventions

keys

A keyboard font is used for single key descriptions.

e.g.

'Press ENTER ' indicates the user should press the large key marked Enter or Return

e.g.

'Press ALT X ' indicates the user should hold down the ALT key and then press the X key

numbers

Numeric data may be entered as a normal decimal number or as a hexadecimal (base 16) number if preceded by a dollar sign ($) character

e.g.

I/O base address = 800

e.g.

I/O base address = $320

{options}

Command line entries which are optional are enclosed in curly brackets {}

e.g.

C>pgen3000 {/i=5} {/p=$320}

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Section A - Introduction

A.1 Product Description

The UPGUTILS software provides support for data files conforming to the D. W. Mann format for the Mann 1600A, 2600, 3000 and 3600 family of pattern generators. The format is used to describe the size, orientation and position of rectangular exposures to be placed on a photographic plate as one of the first steps in the fabrication of semiconductors. A more detailed description of Mann format data is provided in Appendix II.

The UPGUTILS software has the following features:

☐   UPGUTILS reads and writes standard ASCII text files conforming to the Mann format. English and metric pattern generators in the Mann 1600A/2600/3000/3600 family are supported.

☐   UPGUTILS performs bi-directional conversions between DXF (Drawing Interchange Format) ASCII text files and Mann format files. CADD (Computer Aided Design and Drafting) software, such as AutoCAD (©Autodesk Inc.), that supports the importing and exporting of DXF files, can be used to design photomasks.

The DXF to Mann conversion recognises only the following DXF drawing entities: POINT, LINE, POLYLINE/LWPOLYLINE, CIRCLE, ARC, TEXT and an aperture BLOCK. No attempt is made to fracture irregular polygons into rectangular exposures. All recognised entities, regardless of size or orientation, **will** be fractured into one or more rectangular exposures.

☐   The data within a Mann format file can be sorted in order to optimise the production of a photomask. The sorting routine is limited to sorting files with less than 1,000,000 exposures.

☐   The data within a Mann format file can be checked for syntax, range and resolution errors.

A.2 UPGUTILS Contents

This UPGUTILS software is supplied on a high density, 3½ diskette containing the following files:

☐   UPGUTILS.CFG   configuration file containing default settings for pattern generator, conversion options etc.

☐   UPGUTILH.HLP   file containing the on-line help information

☐   UPGUTILS.EXE   Conversion, sorting and verification software for Mann format data
                                       files

☐   SLIDE2.DXF   Sample test pattern showing features of UPGUTILS software (DXF
                                       data file)

☐   SLIDE2.L00   Mann format data file for Metric 3000 pattern generator generated
                                       from SLIDE2.DXF (DXF -> Mann Conversion)

☐   MSLIDE2.DXF   DXF file generated from SLIDE2.L00 (Mann -> DXF Conversion)

A.3 System Requirements

The UPGUTILS software is designed to run on an IBM-PC/AT or compatible personal computer
(PC) with the following **minimum** requirements :

- 640K RAM
- 80286 or better CPU
- one 3½" floppy diskette drive (1.44M capacity)
- CGA/EGA/VGA or monochrome display
- PC/MS-DOS Version 5.0 or greater

Any of the Autodesk Inc. CADD software (AutoCAD, AutoSketch etc.) will be compatible with
UPGUTILS. If the user wishes to use a different CADD package, it should be able to perform the
following :

- define and scale blocks, symbols, components or the equivalent.

- export DXF files. If the user wishes to convert an existing library of Mann files for use with
  the CADD software, then the software must also be able to import DXF files. Blocks must be
  conserved when exporting DXF files i.e. blocks must not be broken down into their individual
  entities when exported.

A.4 Installation

The installation process is straightforward and comprises the following steps :

- Copy all the files on the UPGUTILS diskette to the user's hard drive and to a directory of the user's choosing.

- It is recommended that the PATH setting for the user's machine be modified to include the path holding the UPGUTILS files. This is normally done by editing the computer's AUTOEXEC.BAT file, and appending the directory to the PATH specification.

    e.g. C> PATH={.. previous path setting ..};C:\UPGUTILS

- Modification of the user's CONFIG.SYS file may be required. When performing a DXF to Mann file conversion, one Mann format file is created for each layer in the DXF drawing. The maximum number of layers will be limited by the number of simultaneously open files allowed by the FILES=*XX* setting of the user's CONFIG.SYS file.

    e.g. the typical CONFIG.SYS file might contain the following

        FILES=25
        BUFFERS=20
        DEVICE=ANSI.SYS
        DEVICE=...

    If the value of *XX* above is small and the number of DXF drawing layers is large then the programme may issue an error message of the form

        Unable to create layer file. DOS [4] Too many open files.

    A value of FILES=50 should be enough for most applications.

Section B - Programme Operation

B.1 Startup

To start the UPGUTILS software, enter the following after the DOS prompt:

C> upgutils ⌑ENTER⌑

The introductory screen of Figure B.1 will appear. The user interface is similar to a text based version of Microsoft Windows 3.x/9.x, with mouse support, pull-down menus, windows and user dialogue boxes. The operation of the user interface is described in Appendix I.

Press ⌑ENTER⌑ or mouse click on the **[OK]** button to close the information window.

Figure B.1 : UPGUTILS Introductory Screen

The user screen has the following general layout:

● The top line shows the default pattern generator which will be compatible with Mann files imported or exported by the programme. This can be changed by the user at any time.

- The second line is the Menu Bar from which programme commands can be selected. The current time of day is also displayed on this line.

- The middle area of the screen is the Desktop. This area will show dialogue boxes, error messages and other user interaction windows. The Message Window resides here permanently and provides a scrollable window for viewing user messages.

- The bottom line is the Status Line. Context sensitive hints and help are available from this portion of the screen.

At startup, the Message Window (see Figure B.2) will show the loading of default settings from the file UPGUTILS.CFG if it resides in the current user path.

Figure B.2 : Message Window

At any time, pressing F1 will bring up a context sensitive help system (with hypertext links) with which the user can get more detailed information about the operation of the software.

Pressing ALT X from the main screen will terminate the programme and return the user to the DOS prompt.

B.2 Command Line Options

When invoking the UPGUTILS programme, there are a number of options that can be specified on the command line (video options apply only to users who have purchased UPGVIEW) :

/v   e.g. C>upgutils /v

This option will force the use of a VGA graphics mode when viewing Mann format files, even if the user's display adapter supports graphics modes of a higher resolution. Windows XP will require the use of this option.

/v=xxx

For greater control of the video graphics mode at startup, the user can specify a driver and mode value for the value of xxx

```
/v=0                use the standard autodetect feature
/v=10..14           CGA modes of increasing resolution
/v=30..34           EGA modes of increasing resolution
/v=70..74           Monochrome graphics modes " " "
/v=90..94           VGA modes " " "
/v=160..169         VESA modes " " "
```


/d=command line

Instead of shelling out to a general DOS prompt, the user can chose to always execute a particular program (e.g. a pattern generator control programme) and then return to UPGUTILS when the program is complete.

e.g. **C>upgutils /d=c:\pattgen\pgen1600.exe**   will cause the programme PGEN1600.EXE to be executed when the DOS Shell menu item is selected. When PGEN1600.EXE is terminated, the user will be returned to UPGUTILS.

If a batch file is to be used, a copy of the DOS command processor must be loaded first:

e.g. **C>upgutils /d=c:\command.com@/c@batch1.bat**

The '@' symbol must be used to separate DOS shell parameters so as to avoid confusion with other command line parameters not related to the /d option.

B.3 DXF to Mann Conversion Summary

In order to convert a DXF file to a series of Mann format layer files, the user will usually perform the following steps (more detailed information on the commands in this summary is provided in Section C):
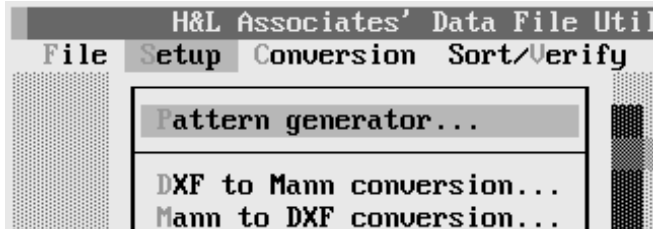
Select a target pattern generator with the user dialogue that appears for this command. Mann format data files generated by the conversion will be compatible with this default pattern generator.
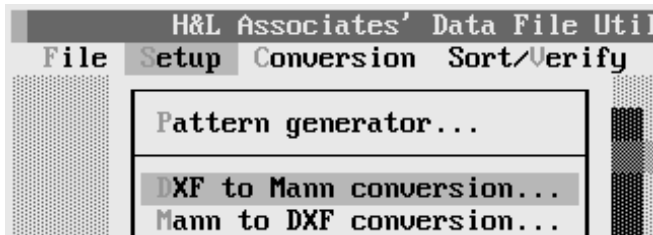
Set the desired default conditions for the DXF to Mann conversion process using the dialogue window that appears for this command. UPGUTILS is shipped with default settings that should be useful for most conversions.
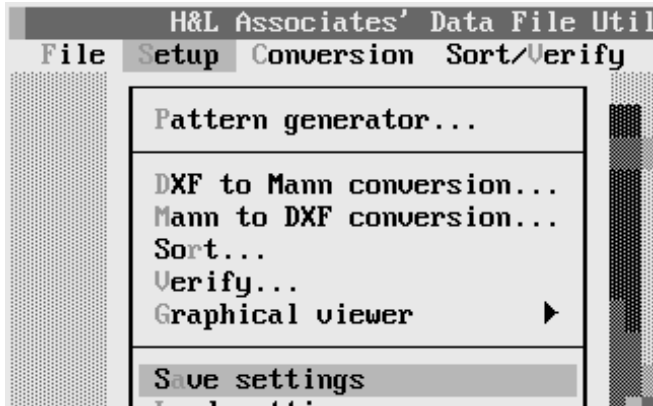
If a number of similar DXF files are to be converted, the current settings can be saved in the file UPGUTILS.CFG in the current path. These settings will become the defaults when UPGUTILS is next invoked.

A user dialogue window appears for this command. Enter the name of the DXF file which is to be converted to one or more Mann format files.
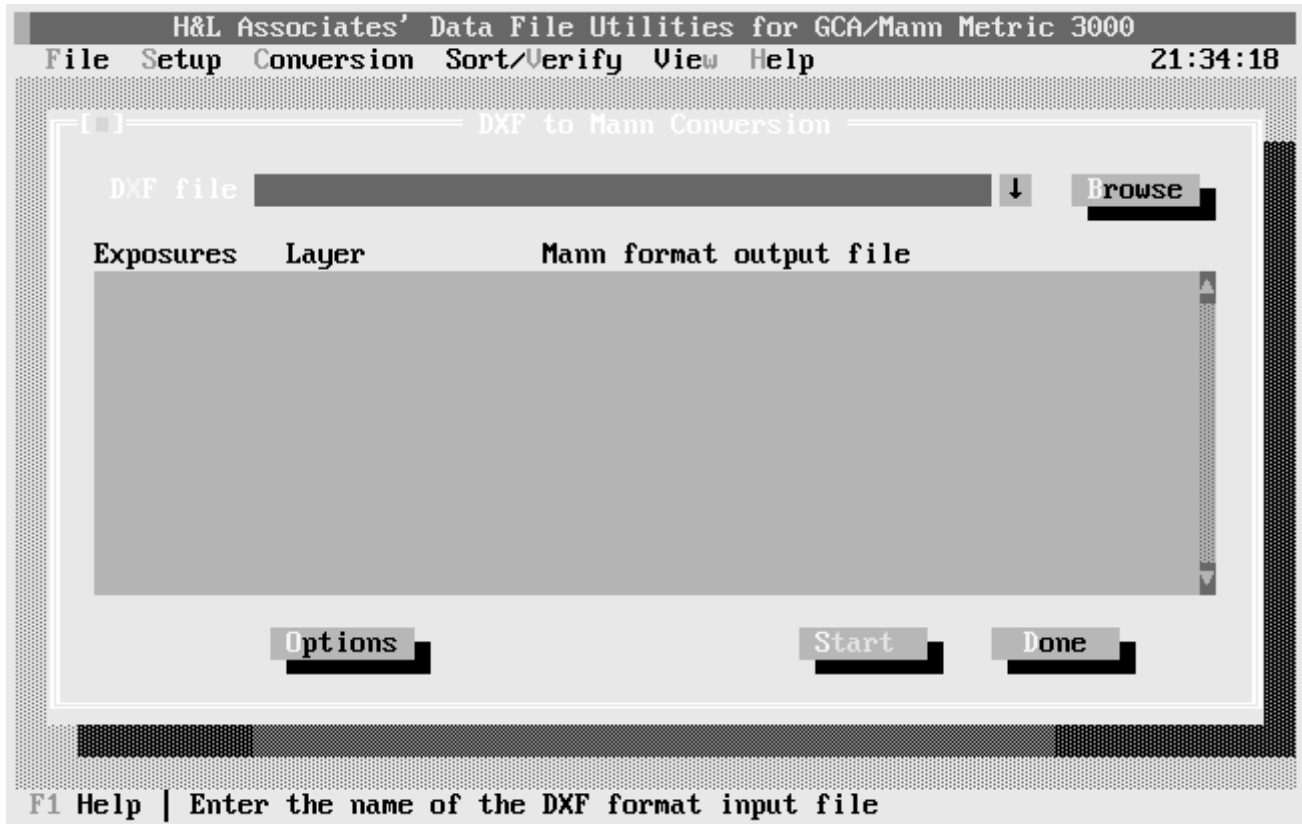
Figure B.3 : DXF to Mann Conversion Dialogue

Press ALT S . This will start the DXF to Mann format conversion. Progress information will be constantly updated on the screen while the conversion is running.

An information window will appear when the conversion is complete. Press ENTER to close this window. A list of the Mann format files created and the number of exposures in each file, will be shown on the screen. Press ALT D to close the user dialogue window.

## B.4 Mann to DXF Conversion Summary

In order to convert one or more Mann format files to a single DXF file, the user will usually perform the following steps:
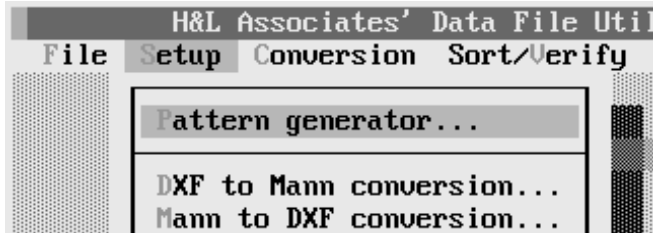
Select a target pattern generator. Mann format data files read during the conversion will be expected to be compatible with this default pattern generator.
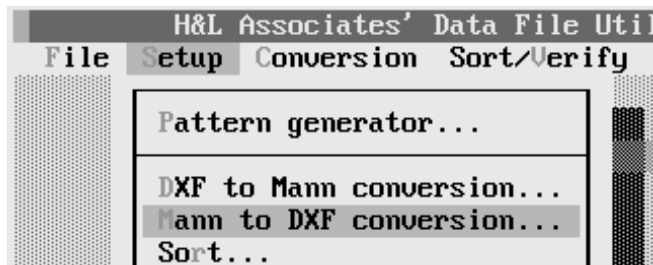
Set the desired default conditions for the Mann to DXF conversion using the dialogue window that appears for this command.
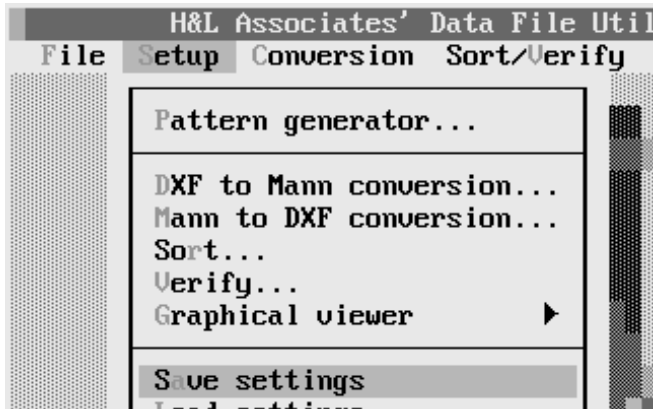
If a number of similar Mann files are to be converted, the current settings can be saved in the file UPGUTILS.CFG in the current path. These settings will become the defaults when UPGUTILS is next invoked.

A user dialogue window appears with this command. Enter the name of the DXF file which will be created by the conversion process.
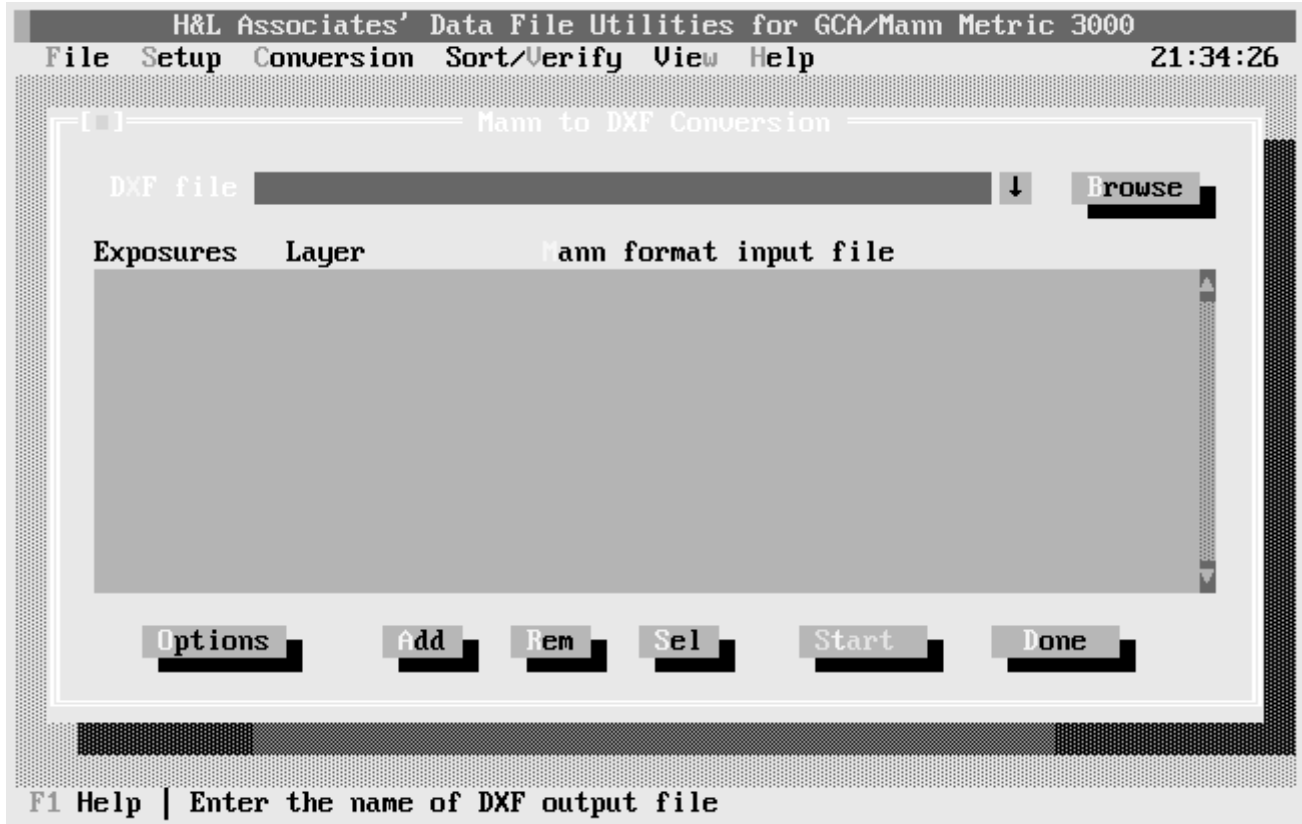
Figure B.4 : Mann to DXF Conversion Dialogue

Start adding the names of Mann format files to the list of files.

- Press [ALT] [A] . A user dialogue will appear prompting for the name of the Mann format file and the layer in the DXF drawing where the exposure data are to be written.
- Press [ALT] [F] and then enter the name of the Mann format file to be converted.
- Press [ALT] [L] and then enter the name of the layer in the DXF drawing file where this Mann file's data are to be stored.
- Press [ALT] [K] to accept the name and layer information and enter it into the file list.

Repeat the above step for as many Mann format files as desired.

When all the required Mann format files appear in the list, press [ALT] [S] . This will start the Mann to DXF conversion. Progress information will be constantly updated on the screen while the conversion is running.

An information window will appear when the conversion is complete. Press [ENTER] to close the window. A list of the Mann format files imported and the number of exposures in each file, will be listed on the screen. Press [ALT] [D] to close the user dialogue.

B.5 Sorting Summary

In order to sort the exposure data in a Mann format data file, the user will usually perform the following steps:
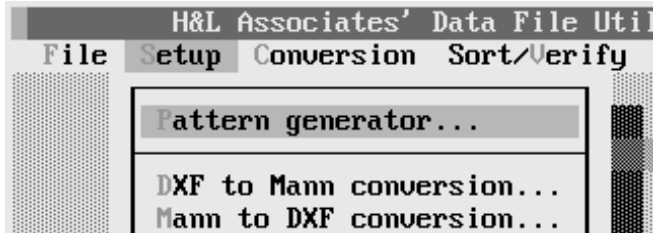

Select a target pattern generator. Mann format data files read during the sort will be expected to be compatible with this default pattern generator.
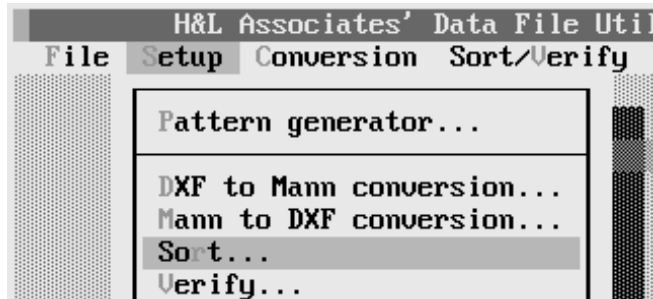
Set the desired default conditions for the Mann file exposure sorting process using the dialogue window that appears with this command.
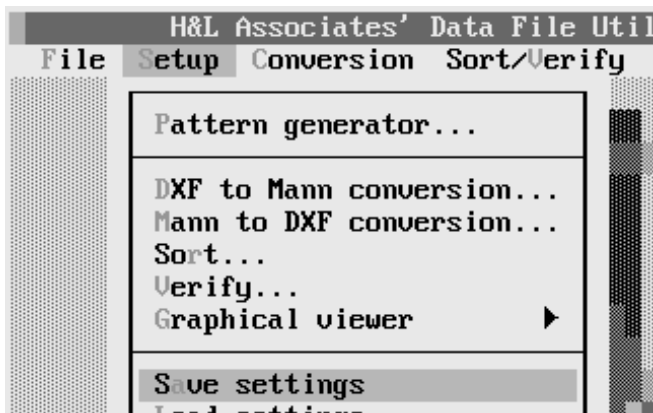
If a number of similar Mann files are to be sorted, the current settings can be saved in the file UPGUTILS.CFG in the current path. These settings will become the defaults when UPGUTILS is next invoked.
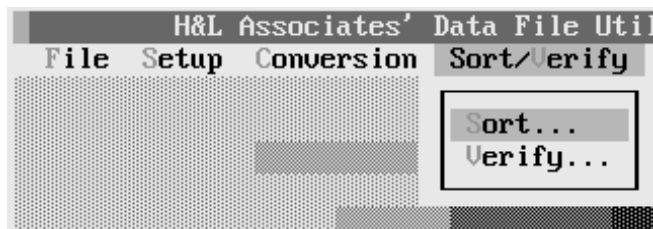
A user dialogue window appears with this command. Enter the name of the Mann format data file containing the exposures to be sorted.
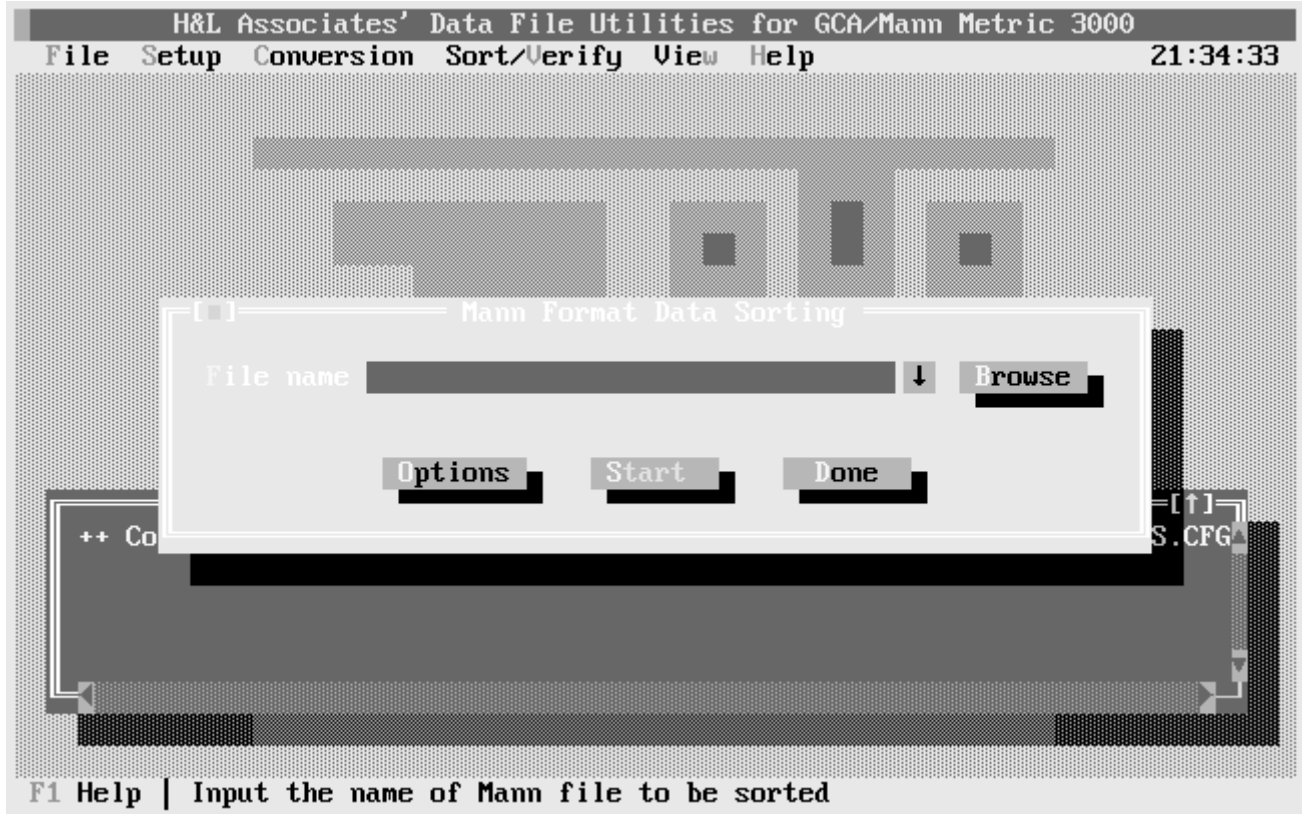
Figure B.5 : Mann Data Sorting Dialogue

Press ⌊ALT⌋ ⌊S⌋ to start the Mann format file sort. A progress indicator will be updated on the screen while the sort is being performed. Press ⌊ENTER⌋ to acknowledge and close the window that appears when the sort is complete. Press ⌊ALT⌋ ⌊D⌋ to close the user dialogue window.

When complete, a Mann format file will have been created with the same name as the input file but with a .SRT extension (or a .Sxx extension if the source file had a .Lxx extension). This file will hold the same exposure data as the source file but arranged in the sort order specified by the user.

B.6 Verification Summary

In order to check a Mann format file for range, syntax and resolution errors, the user will usually perform the following steps:
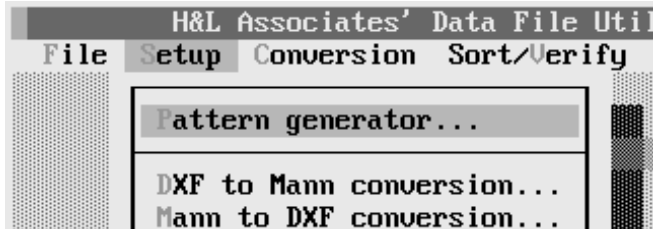

Select a target pattern generator. Mann format data files read during the verification will be expected to be compatible with this default pattern generator.
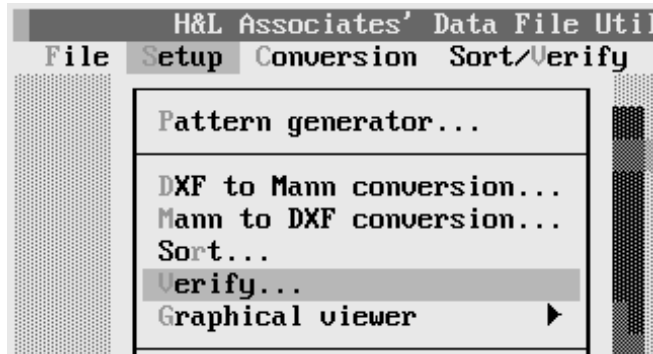
Set the desired default conditions for the Mann file exposure verification process using the dialogue window that appears with this command.
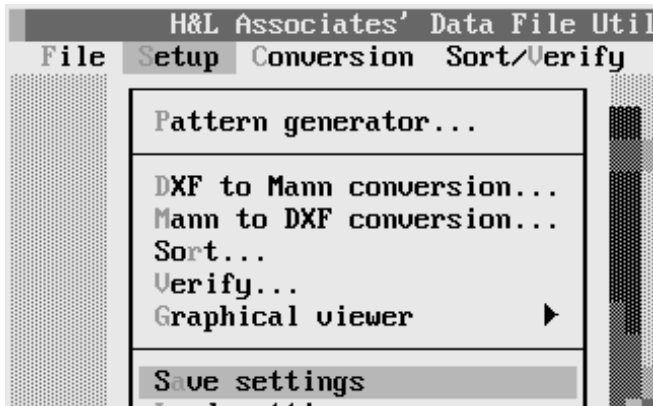
If a number of similar Mann files are to be verified, the current settings can be saved in the file UPGUTILS.CFG in the current path. These settings will become the defaults when UPGUTILS is next invoked.
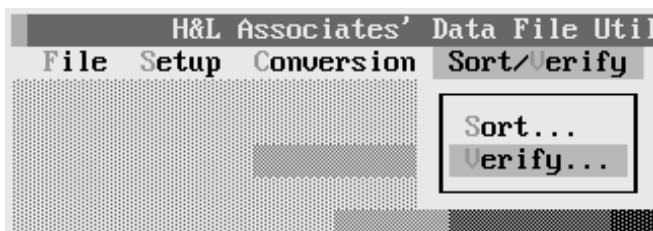
A user dialogue window appears with this command. Enter the name of the Mann format data file containing the exposures to be checked for range and resolution errors.
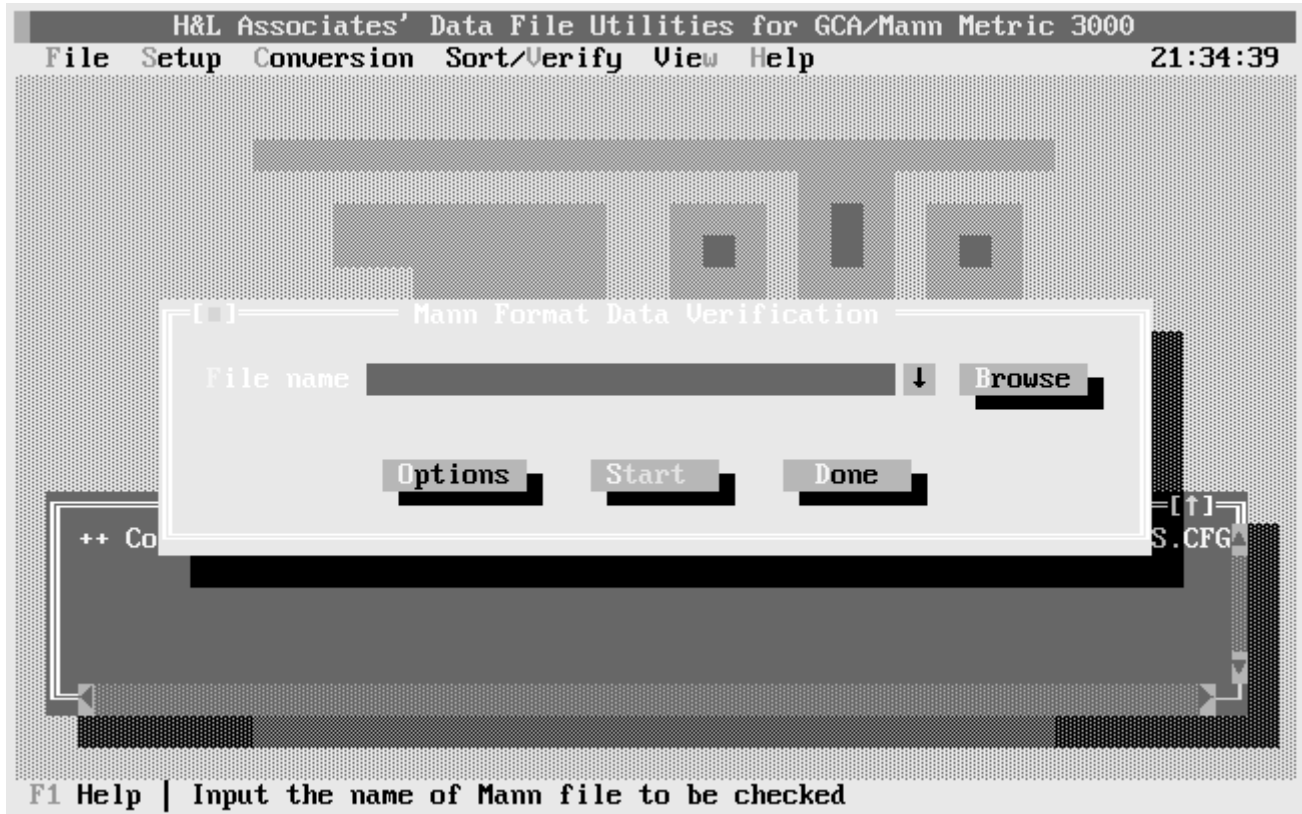
Figure B.6 : Mann Data Verification Dialogue

Press ⟦ALT⟧ ⟦S⟧ to start the Mann format file verification. Any error or warning messages generated will appear in the Message Window. Press ⟦ENTER⟧ to acknowledge and close the window that appears when the verification is complete. Press ⟦ALT⟧ ⟦D⟧ to close the user dialogue window.

When complete, error and warning messages, as well as a summary of the information in the Mann format file will be in the Message Window. The user can 'zoom' this scrollable window to look at the information.

Section C - Command Summary

C.1 File │ Change dir...
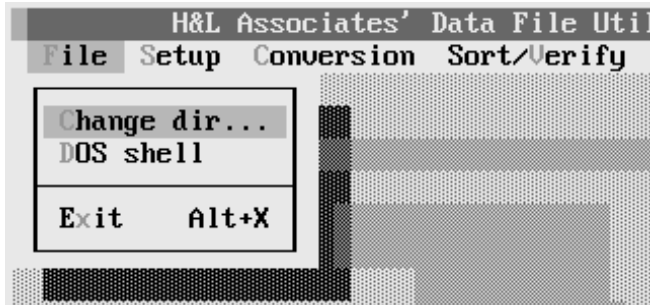
Selecting this command will present the user with a Change Directory dialogue window. From here, the user can change the currently active path. The programme looks first in the current path for data and configuration files.

The Change Directory dialogue of Figure C.1 has the following parts:
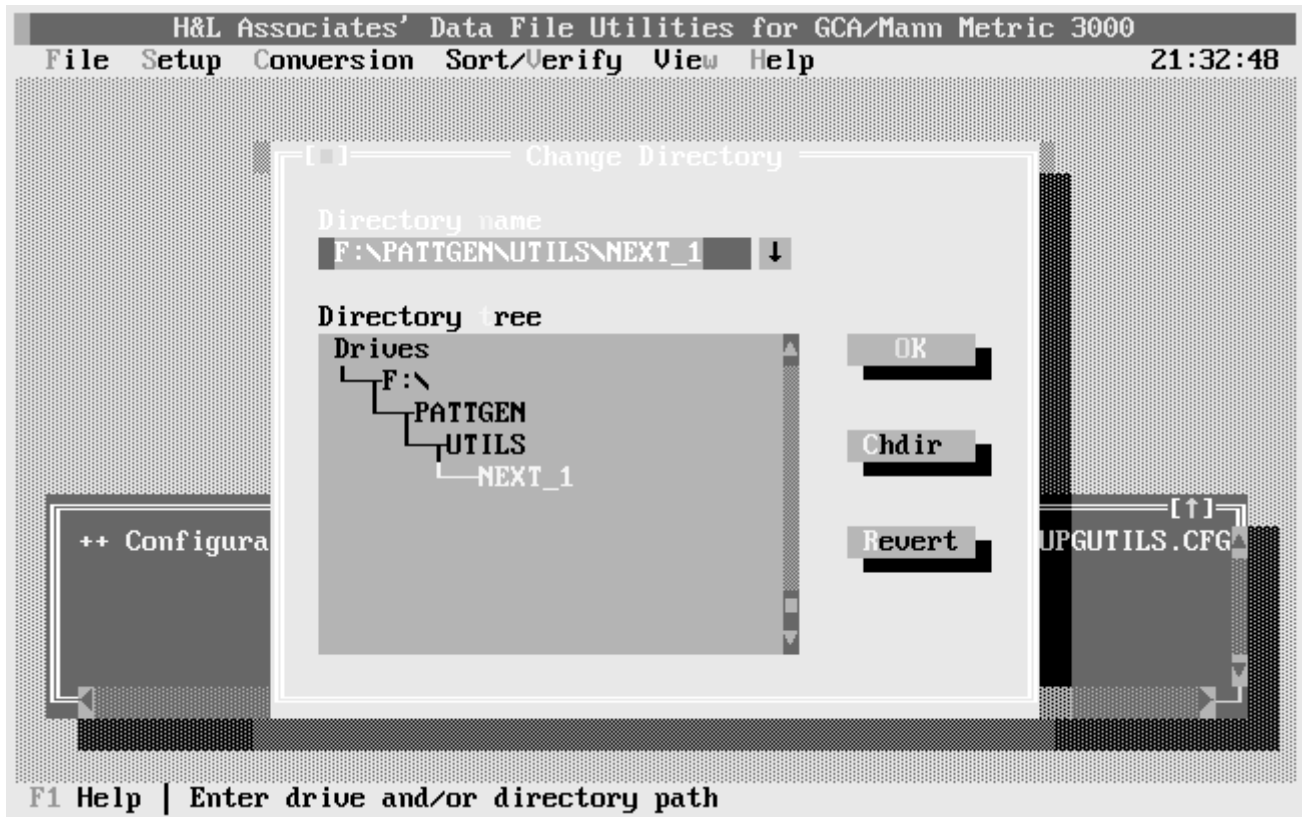
**Figure C.1** : Change Directory Dialogue

In the **Directory name** input line, the user enters the name of the path which is to be made current.

The **Directory tree** list box enables the user to navigate directories by using the cursor keys to move the highlighting bar to the desired path and then pressing ⌷ENTER⌷ , or by using the mouse and double clicking on the desired path name. Pressing ⌷ENTER⌷ or mouse clicking on the **[Ok]** button makes the selected directory the current directory.

Pressing the **[Chdir]** button changes the current directory to the path name that has been selected or typed into the **Directory name** input line.

Pressing the **[Revert]** button returns the user to the directory that was in effect when the Change Directory dialogue was first invoked.

C.2 File│DOS shell
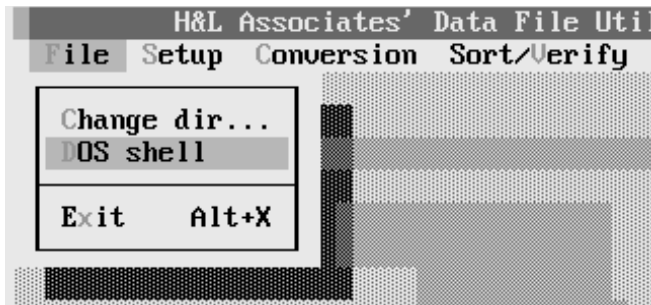
With the DOS Shell command, the user can leave the UPGUTILS programme temporarily to perform a DOS command or to run another programme.

To return to the UPGUTILS programme, type **exit** at the DOS prompt. Please ensure that the commands executed from inside the DOS shell are simple and well behaved. Loading Terminate and Stay Resident (TSR) programmes, such as the DOS MODE and PRINT commands, will affect memory and probably cause the UPGUTILS programme to fail.

C.3 File│Exit (Alt+X)

Selecting the Exit command will cause the UPGUTILS programme to terminate. The user will be returned to the DOS prompt. Pressing ⌷ALT⌷ ⌷X⌷ from the main screen will also cause the programme to terminates.

C.4 Setup│Pattern generator...
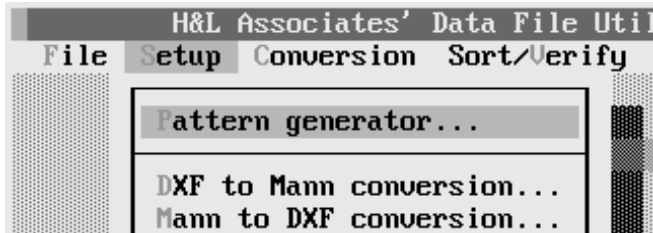
This command allows the user to select the default pattern generator. Mann format files generated by UPGUTILS will be suitable for mask generation on the selected pattern generator. Mann format files read by UPGUTILS must be compatible with this default pattern generator.

The user dialogue of Figure C.2 will appear. It consists of three check boxes:
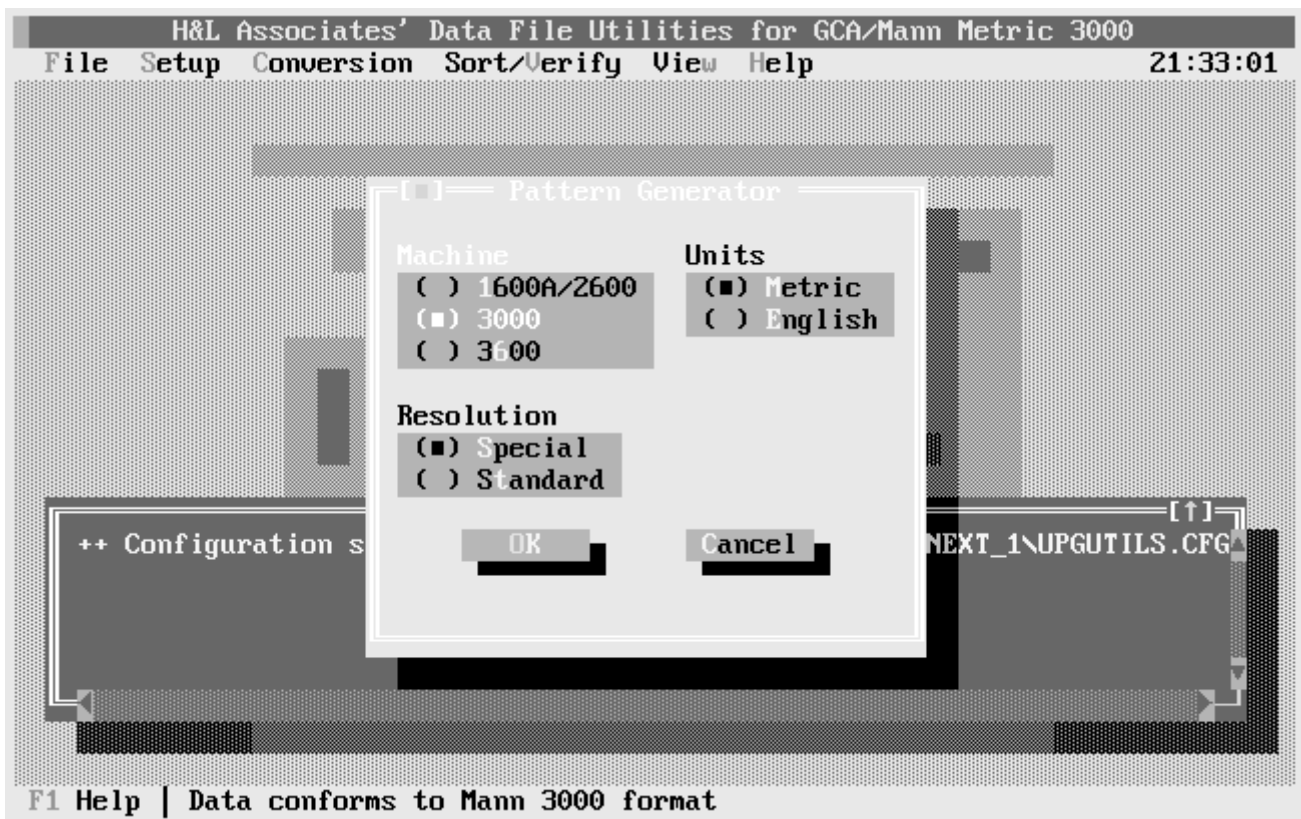

Figure C.2 : Pattern Generator Selection

● exposure data may be expressed in English (inches) or metric (millimetres) units
● the pattern generator may be one of the GCA/D.W.Mann 1600A, 3000 or 3600 series. The Mann 2600 can be considered to be the same as the 1600A as far as the data format is concerned
● the early 1600A models came in standard and special models, with the standard having one-half the aperture resolution of the special. This check box will be enabled only if a 1600A/2600 pattern generator is selected.

C.5 Setup│DXF to Mann conversion...

The DXF entities LINE, POLYLINE, CIRCLE, TEXT and APERTURE will be recognised and converted to a series of rectangular exposures. The configuration command allows the setting of various options which control just how these entities are converted.
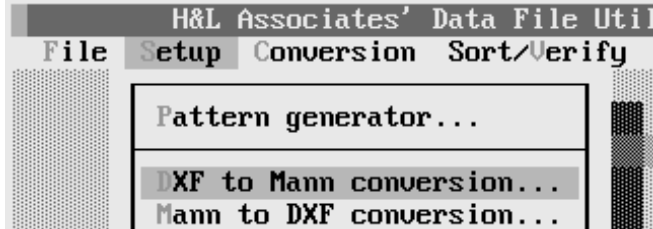
This command will invoke a DXF to Mann configuration dialogue box. The user can then set various options to control the manner in which the conversion is performed.
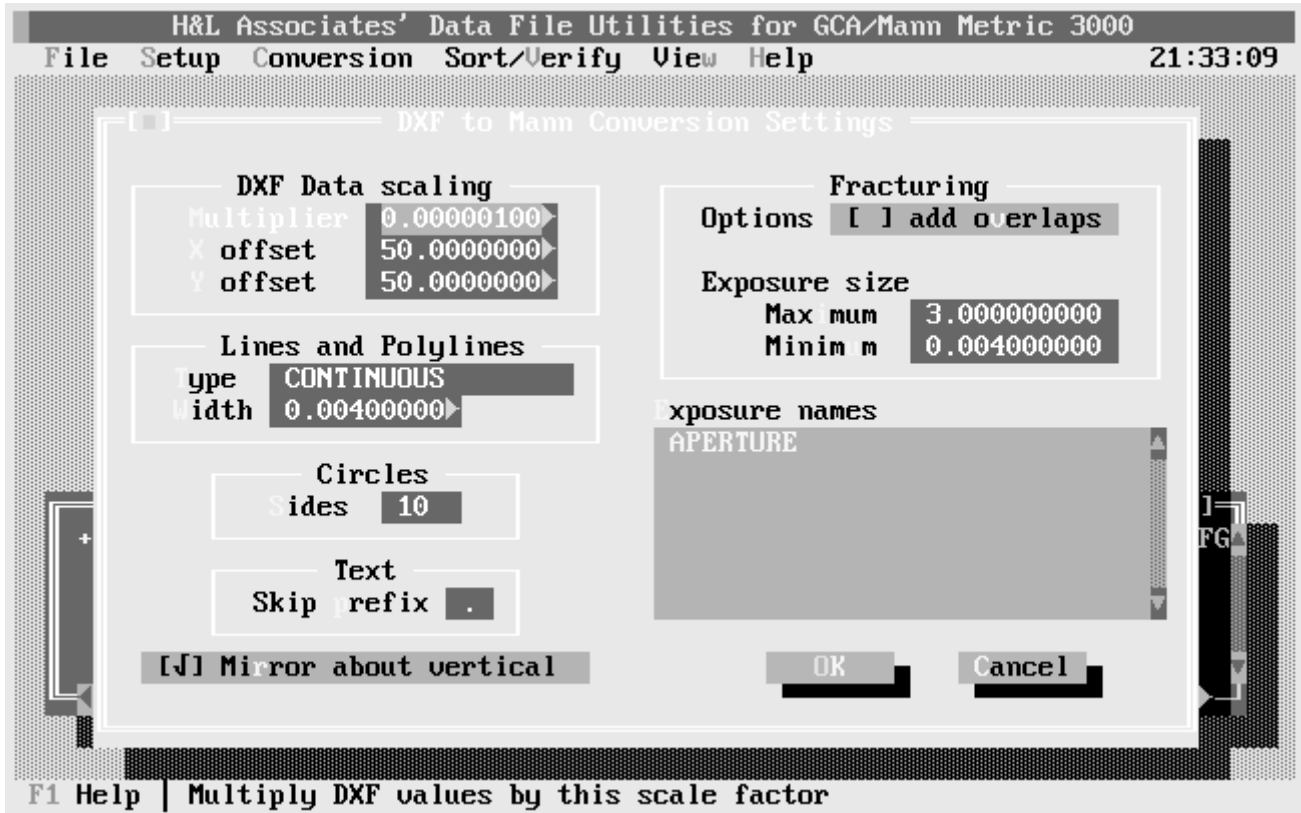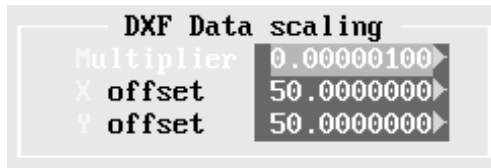

Figure C.3 : DXF to Mann Configuration

Any floating point numerical values read from the DXF file will be multiplied by the value entered in the **Multiplier** field. If the numerical value is part of an (X,Y) coordinate pair that defines the position of an object, then the values can be adjusted by adding the **X offset** and **Y offset** values to the X and Y coordinates respectively (after the scaling factor has been applied).

For example, if the DXF file was created using units of mils (thousandths of an inch), setting the **Multiplier** value to 0.0254 would cause the Mann format output files to be in millimetre (metric) units. In addition, if the DXF file was designed for a metric GCA/Mann 3600, with the origin at the centre of the image, then setting the X and Y offset values to 50.00 would produce Mann files suitable for use on a Mann 3000 pattern generator.

DXF lines and polylines will be converted into a series of long, thin rectangular exposures. DXF lines and polylines have a line type associated with them such as DOTTED, DASHED or CONTINUOUS. Only lines and polylines of the type entered in the **Type** field will be converted to Mann exposures. All other line types will be ignored. For the special case where the polyline defines a rectangle, the polyline will be treated the same as an Aperture Block.

Since DXF lines have no actual width associated with them, the user must specify a width to be used when producing an exposure. This value is entered in the **Width** field and defaults to the minimum aperture size allowed for the selected pattern generator.

Polylines do have width information attached to them when they are created. If a width has not been specified, it will default to the value in the 'Width' field. In addition, for each polyline, only the first 500 segments will be converted to exposures.

A DXF circle will be approximated by an **n**-sided (**n** is even) regular polygon before conversion to a series of rectangular exposures. The value of **n** is entered in the **Sides** field.

The conversion process will produce **n**/2 identical rectangular exposures rotated about a common centre and separated from each other by 360/**n** degrees. The value of **n** is limited to an even number between 4 and 100. Note that for POLYLINEs with a bulge factor (i.e. curved polylines), the value of **n** will also be used to determine the number of straight line segments used to approximate the curve.
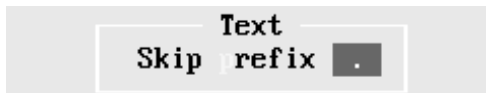
DXF text which begins with the **Skip prefix** character will be ignored during conversion and entered as a comment into the Mann format output file.

For all other DXF text strings, each character will be converted into a series of exposures using a fixed pitch, 8x8 pixel, IBM-PC character set. No attempt is made to match a DXF font, and proportional character spacing will be ignored. Vertical and horizontal scaling factors can be used in the DXF text, as well as most justification schemes that don't involve trying to proportionally fit text into a given space.

If this option is checked, then the Mann format data will be reflected about the vertical axis during the conversion.

This adjustment is done by default in order to compensate for the difference in coordinate systems between DXF and Mann format data. Unless otherwise defined, the two dimensional (2D) coordinate system for DXF files uses the standard X,Y rectilinear setup, with the origin (0,0) located in the lower left hand corner, positive X axis values increasing to the right, positive Y-axis values increasing upwards and positive angles measured counterclockwise from the positive X axis. Note that this is not the same as the coordinate system used in Mann format files.
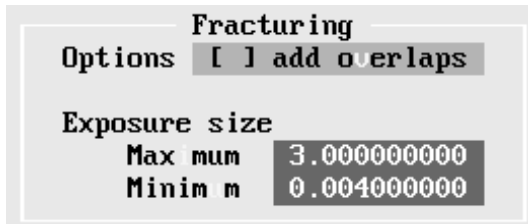
Any APERTURE exposure can be too large to produce in a single 'flash' on a given pattern generator. It must then be broken (or fractured) into a series of smaller, adjacent exposures, each of which is within the capability of the pattern generator. Depending on the resolution of the selected pattern generator, and the angle of the large exposure, it is possible for small gaps to appear between the fractured exposures.

If the **add overlaps** option is checked, then thin exposures will be added to cover the joints where any two fractured exposures meet, and small square exposures will be added to cover the corners where any four fractured exposures meet. The length and width of these 'patching' exposures can be specified in the **Maximum** and **Minimum** fields.
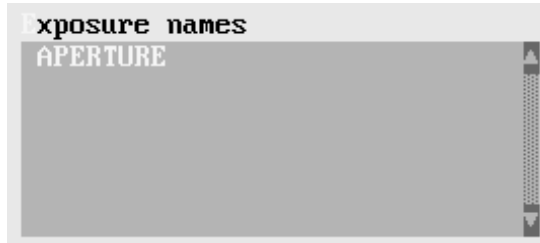
When using Computer Aided Design & Drafting (CADD) software to produce photomask patterns, the user is required to work with scaled rectangular blocks. These blocks will represent exposures on the final photomask. They can be of any size and positioned anywhere and at any angle.

The conversion software will recognize scaled DXF blocks having names that appear in this list and convert them directly to rectangular Mann format exposures. New names can be entered into the list by pressing INS . Using the cursor keys, or the vertical scroll bar, to highlight a name, and then pressing DEL will remove the highlighted name from the list. Highlighting a name and pressing ENTER (or double clicking on the name) will allow settings for the aperture block to be modified.

When an aperture block is to be created or modified, a dialogue box will appear, prompting for the name of the block to be added/modified and the settings for various parameters.
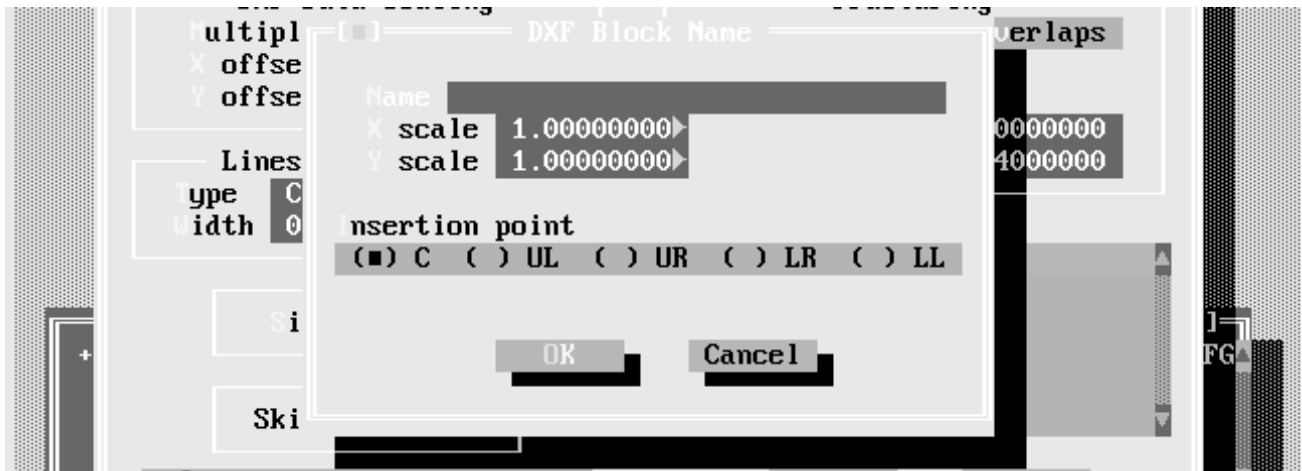

Figure C.4 : DXF Aperture Block Definition

Enter the name of a block into the **Name** field. The aperture block is usually a unit square, but rectangles of any size can be used to construct masks. The X and Y dimensions of this rectangle can be specified using the **X scale** and **Y scale** input lines.

DXF objects usually have an insertion point which serves as a local origin when moving or placing the object. For a unit square aperture block, this reference point is usually the centre of the square. Using the **Insertion point** checkbox, the user may define the reference point to be the centre **(■)C** or the upper left **(■)UL**, the upper right **(■)UR**, the lower right **(■)LR** or the lower left **(■)LL** corner of the rectangle.

C.6 Setup│Mann to DXF conversion...
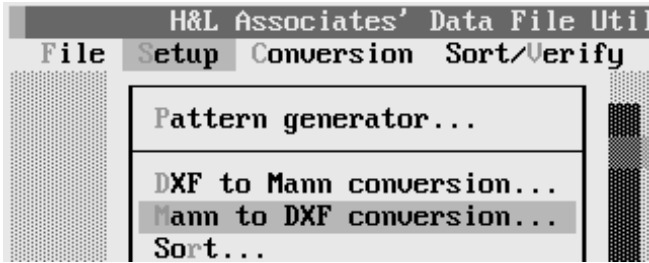
This command will invoke a Mann to DXF configuration dialogue box as shown below. Each exposure within a Mann file will appear in the DXF file as a scaled rectangular block (or component). Multiple Mann files can be specified, with each file appearing on a layer of the user's choosing within the DXF file.
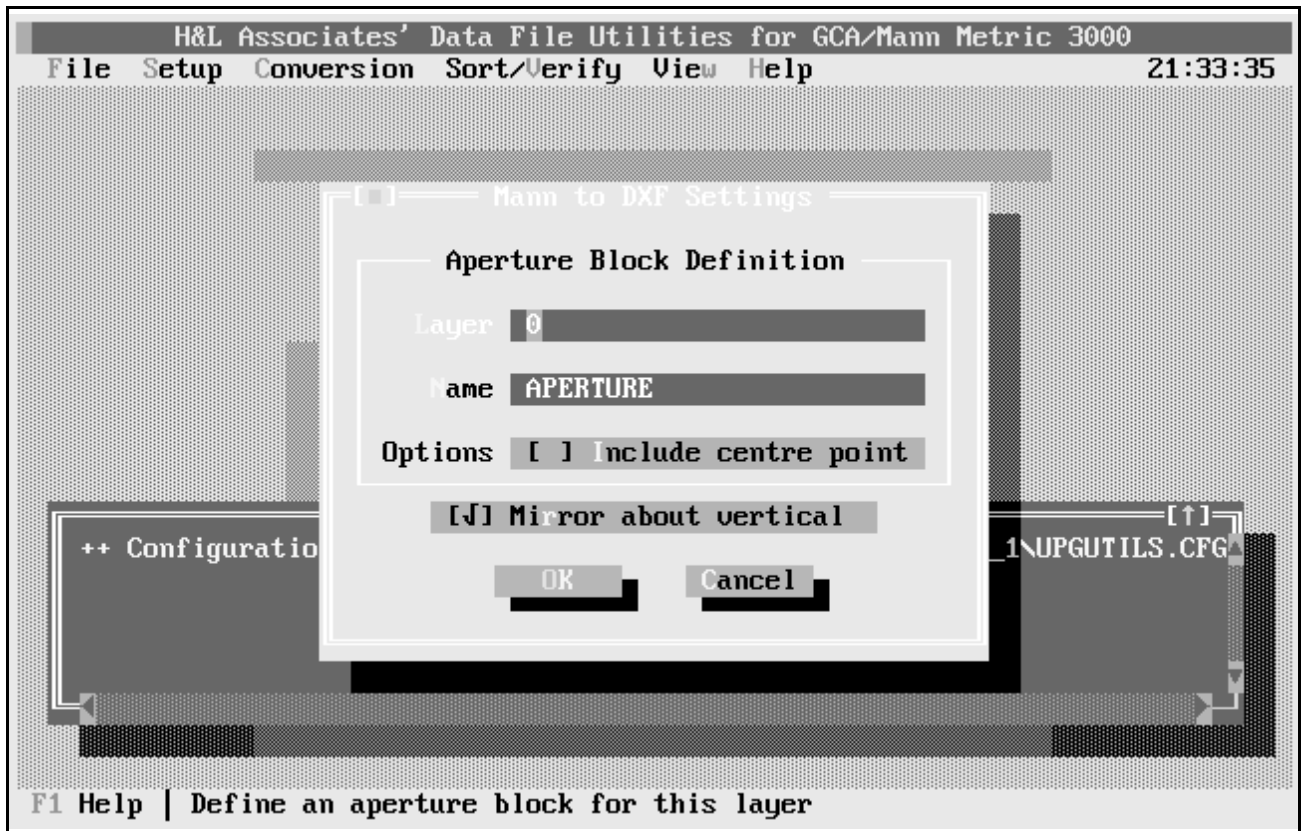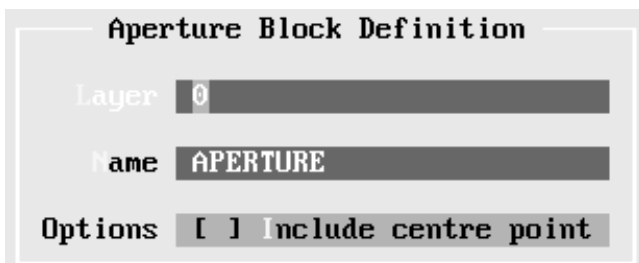

Figure C.5 : Mann to DXF Setup Dialogue

When converting a Mann format file to DXF, an aperture block definition will be written to the DXF file. The block will be defined for a user specified **Layer** and given the user specified **Name**. If the **Include centre point** option is checked, then a single point will be added to the centre of the unit square in order to simplify selection and placement of the block.

If this option is checked, then the Mann format pattern will be reflected about the vertical axis. This is the default condition since the DXF and Mann coordinate systems consider the positive X axis to be in opposite directions. The user may already have taken this into account when making the pattern and can turn this adjustment off.

C.7 Setup│Sort...

The sort feature of this software rearranges the exposure data in a Mann format file in order to minimise the time required to generate a photomask. On GCA/Mann pattern generators the Y axis stage motor is generally the slowest so minimising its motion will tend to minimise the total plate exposure time. Sorting a data file will also cause duplicate exposures (exposures with identical X, Y, H, W and A settings) to be removed. Exposure settings with resolutions not compatible with the target pattern generator will have those values truncated to the proper resolution.

Exposures in the data file are sorted in ascending order (smaller value items occur before larger value items) based on user defined keys. The five sort keys represent the settings for each of the standard exposure settings : X, Y, W, H and A. Exposures with the same primary key value will then be sorted based on the secondary (2nd) key exposure setting. Exposures with the same secondary key value will then be sorted based on the tertiary (3rd) key exposure setting and so on. This is repeated for each of the five possible exposure settings. The default sort order is Y, X, H, W and then A.

Exposures with the same Y axis value can also be sorted on the X axis value in either ascending or alternating order.
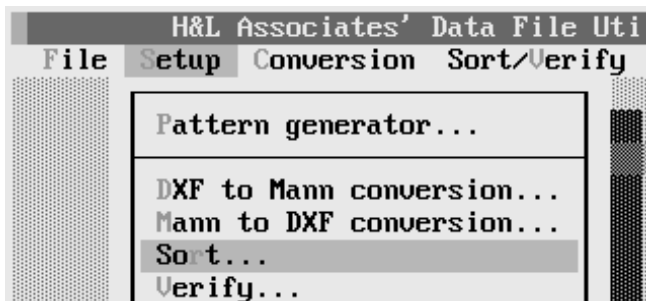
This command will invoke a configuration dialogue for selecting the kind of sorting to be performed on the exposures in a Mann format data file.
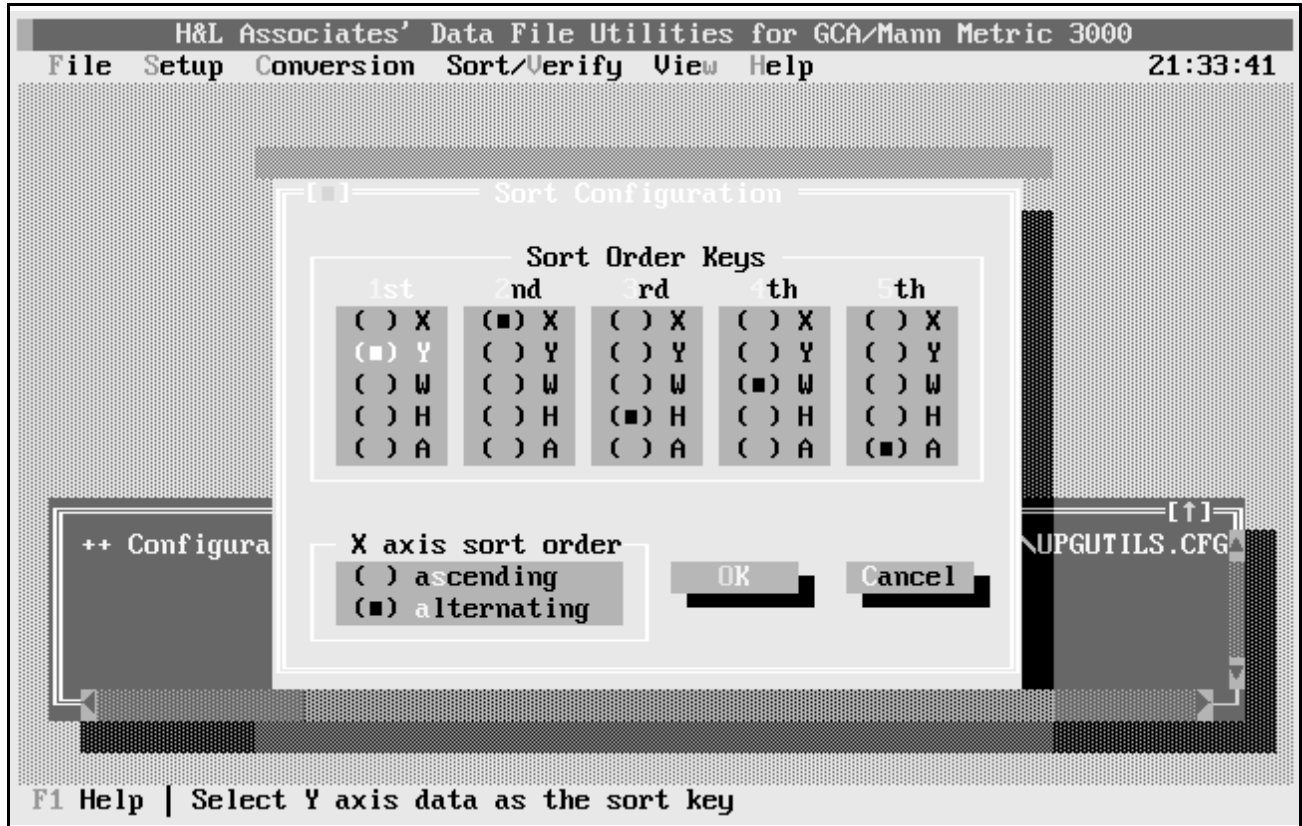
Figure C.6 : Mann Data Sorting Setup Dialogue

This dialogue box allows the user to select the sort keys and whether the exposures are to be sorted in alternating or ascending order based on the X axis stage setting. The user can select the exposure setting that will be used as the primary (1st) sort key, as well as the 2nd, 3rd, 4th and 5th keys, so long as each key is used only once.

If ascending order is selected, X axis values will be sorted in simple ascending order for Y axis settings of the same value.

  e.g. Y100X100;X200;X300;
     Y200X300;X600;X900;
     Y300X100;X200;X300;....

If alternating order is selected, then every time the Y axis value changes the X values will alternate between being sorted in ascending order and descending order.

  e.g. Y100X100;X200;X300;
     Y200X900;X600;X300;
     Y300X1000;X2000;X3000;
     Y400X4300;X4200;X4100;...

Ascending order is preferred for the Mann 1600A pattern generators which can only make exposures while the X axis staging is moving in a positive direction. Alternating order is preferred for all other pattern generators which can make exposures in both directions of X axis stage motion. Exposures with the same X and Y values will be sorted in ascending order based on the H, W and then A values according to the previous selected sort keys.

C.8 Setup│Verify...
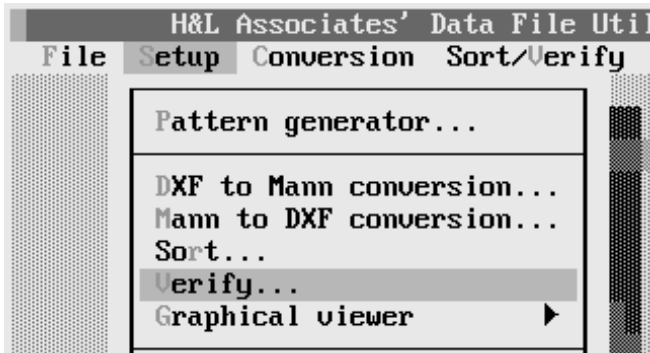
This command will invoke a configuration dialogue for setting the limits on exposures in a Mann format data file. Each exposure within a Mann file will be checked for proper syntax, and for settings that are within the capabilities of the default pattern generator.

When making a photomask, the target pattern generator usually has a feature whereby the user can adjust all the exposures in a pattern file by:

- adding/subtracting a fixed number of steps to/from the H and W settings
- adding an offset to the X and Y axis settings

This dialogue box will allow the same adjustments to be made to all exposures in a Mann format data file during verification in order to check for possible problem flashes.
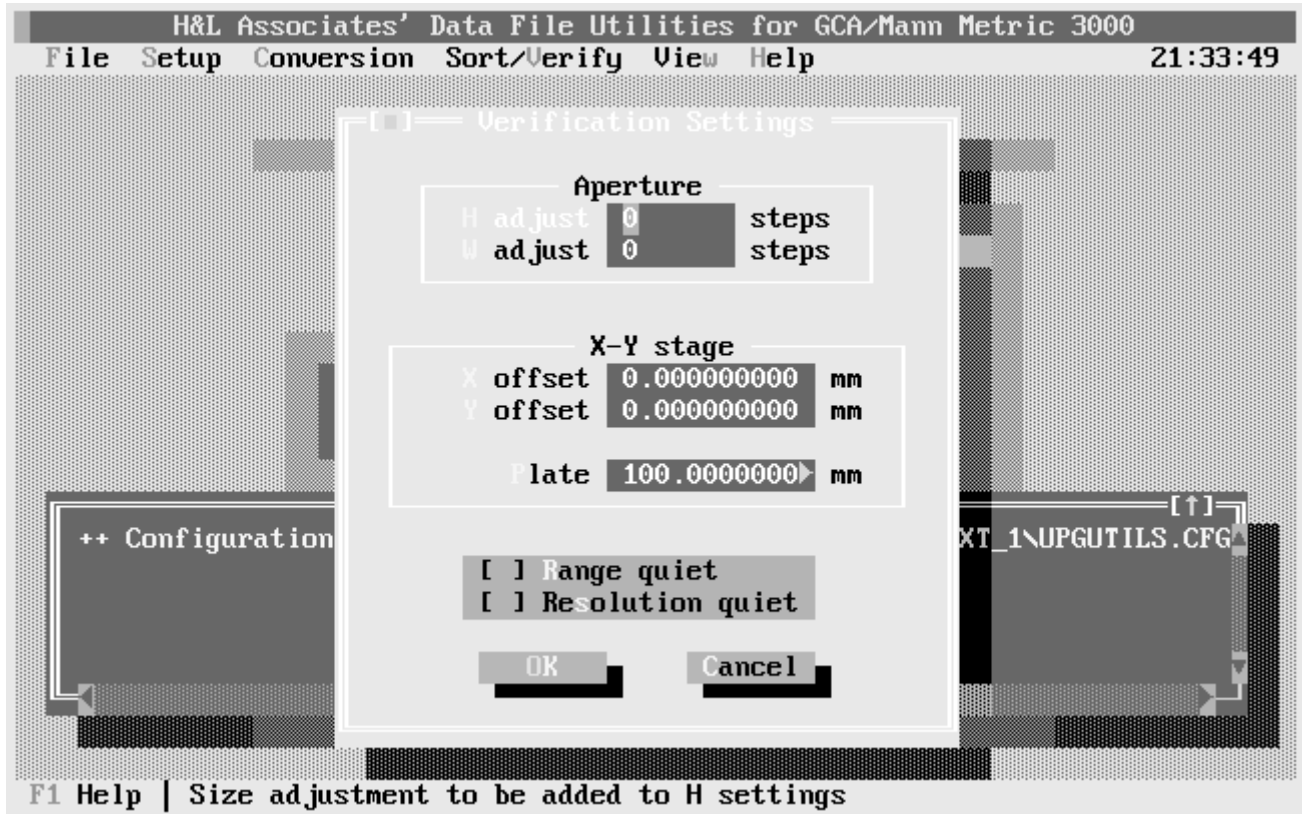
**Figure C.7** : Mann Data Verification Setup Dialogue

The user can specify the adjustment to be made to all H and W setting, measured in steps (either positive or negative). A step will represent the aperture resolution for the target pattern generator e.g. 0.001 mm for a Mann 3000, 0.00025" for an English 1600A
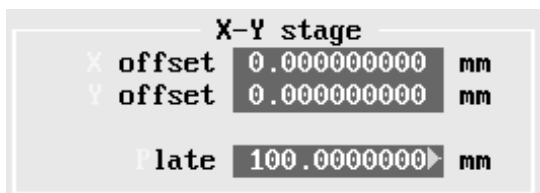
The user can specify the **X offset** and **Y offset** amounts to be added to all X and Y settings of the exposures in the Mann format file. During verification, these offsets will be added and the result checked against the specified size of the square **Plate**. Any exposures which would not fall on the photomask plate will be noted.
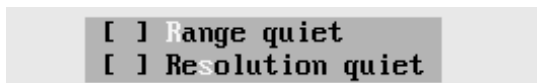
If the **Range quiet** option is checked, then messages warning of an exposure setting being out of range, will be suppressed. If the **Resolution quiet** option is checked, then messages warning of an exposure setting with an invalid resolution, will be suppressed. Messages are normally sent to the Message Window during the verification process.

Range errors will be noted if the X and Y settings of an exposure will cause it to be made outside the photomask area. A range error will also be noted if one or more of the aperture settings (H, W and A) of the exposure are beyond the capabilities of the default pattern generator. See Appendix II for a description of the resolution of the various pattern generators.

Resolution errors are noted if any of the settings of an exposure are beyond the resolution capabilities of the target pattern generator. For example, metric GCA/Mann 3000 pattern generators have a resolution of 0.001 mm on the X and Y settings of an exposure. A metric Mann 2600 pattern generator allows a resolution on the X and Y settings of 0.005 mm. Verifying a pattern file designed for a Mann 3000 using a Mann 2600 as the default will result in a number of resolution errors being noted.

C.9 Setup│Save settings
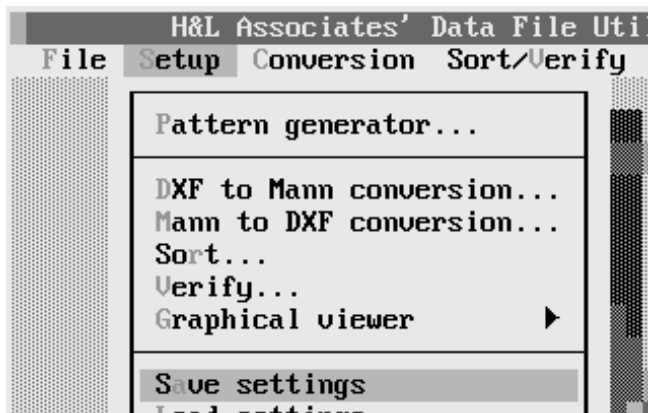
This command will cause the current default settings to be saved in the file 'UPGUTILS.CFG' in the current path.

C.10 Setup│Load settings
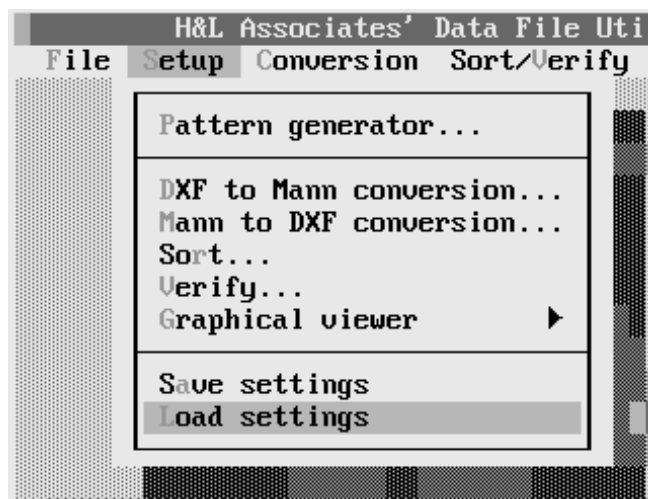
This command will cause the default settings to be loaded from the file 'UPGUTILS.CFG' in the current path. The title at the top of the screen may change to reflect the pattern generator currently being supported.

C.11 Conversion│DXF to Mann...
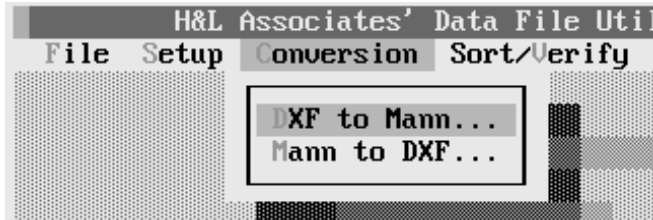
Selecting this command will invoke the DXF to Mann Conversion dialogue. This allows the user to locate and select a DXF file for conversion to one or more Mann format files.

The conversion will begin when the **[Start]** button is pressed and finish when all recognised entities in the DXF file have been converted to exposures suitable for use with the target pattern generator. As each Mann format output file is created, it's name will appear in the list of files, along with it's associated DXF layer name and a count of the number of exposures in the file.
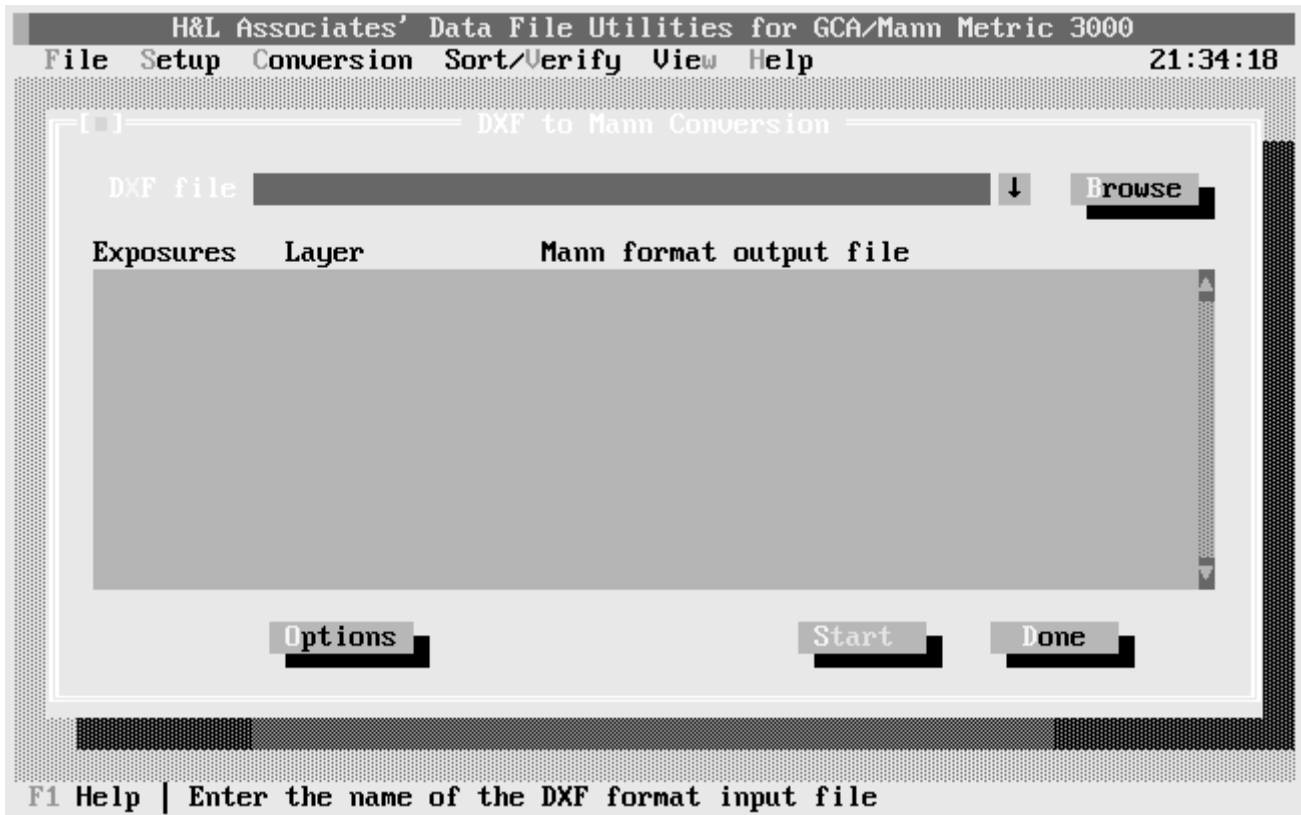
Figure C.8 : DXF to Mann Conversion Dialogue

This **DXF file** input line allows the user to enter the name of the DXF file which is to be converted to one or more Mann format output files. Pressing the **[Browse]** button will bring up a standard file selection dialogue box (see Section I.4.3) with which the user can locate a DXF file for conversion.

As each layer is encountered in the DXF drawing file, a Mann format file will be created to hold that layer's exposure data. The Mann format file name will appear in the main list box. Each Mann file will have the same name as the DXF input file, except that the extension will be numbered to represent the position of the Mann file in the list e.g. a three layer DXF file named TEST1.DXF will produce three Mann format output files named TEST1.L00, TEST1.L01 and TEST1.L02.

The corresponding DXF layer name for each Mann file will also appear in the list. As an exposure is added to a Mann file, the flash counter for that file will be updated.

Pressing the **[Options]** button will invoke the DXF to Mann setup dialogue (see Figure C.3).

Pressing the **[Start]** button will begin the DXF to Mann conversion process. The drawing entities which are recognised by this software (LINEs, POLYLINEs, CIRCLEs, TEXT and Aperture BLOCKs) will be converted to Mann format exposures suitable for the target pattern generator. Unrecognised block names will appear in the message window.

The conversion process can be interrupted at any time by pressing ESC .

Pressing the **[Done]** button will close and remove the dialogue box.

C.12 Conversion│Mann to DXF...

Selecting this command will invoke the Mann to DXF Conversion dialogue. This allows the user to locate and select one or more Mann files for conversion to a DXF file.

The desired DXF output file is also selected. The conversion will begin when the [Start] button is pressed and finish when all Mann format files have been processed. The user may interrupt the process at any time by pressing ESC .

In the **DXF file** input line, the user enters the name of the DXF file which will hold all the exposure information extracted from the Mann format files appearing in the list of files.
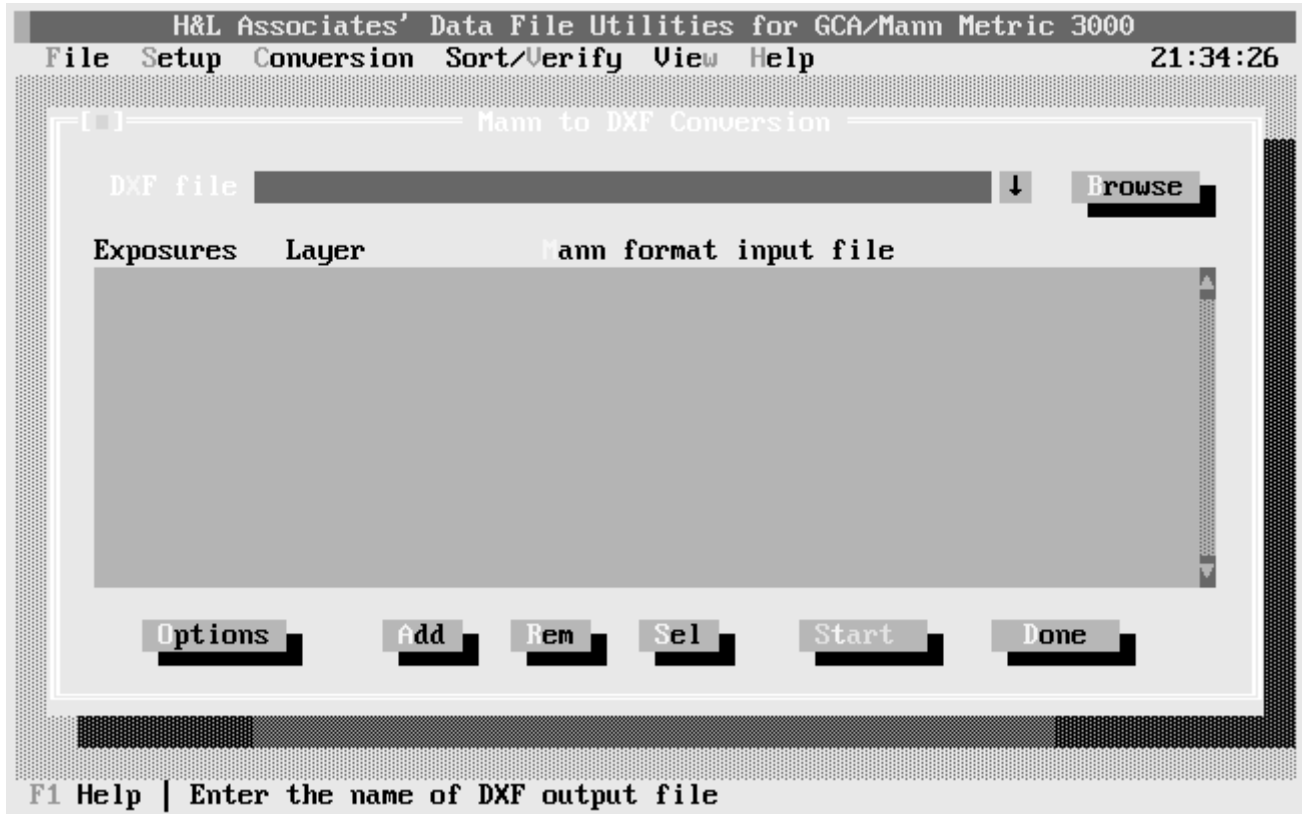
Figure C.9 : Mann to DXF Conversion Dialogue

Pressing the **[Browse]** button will bring up a standard file selection dialogue box (see Section I.4.3) with which the user can locate a DXF output file.
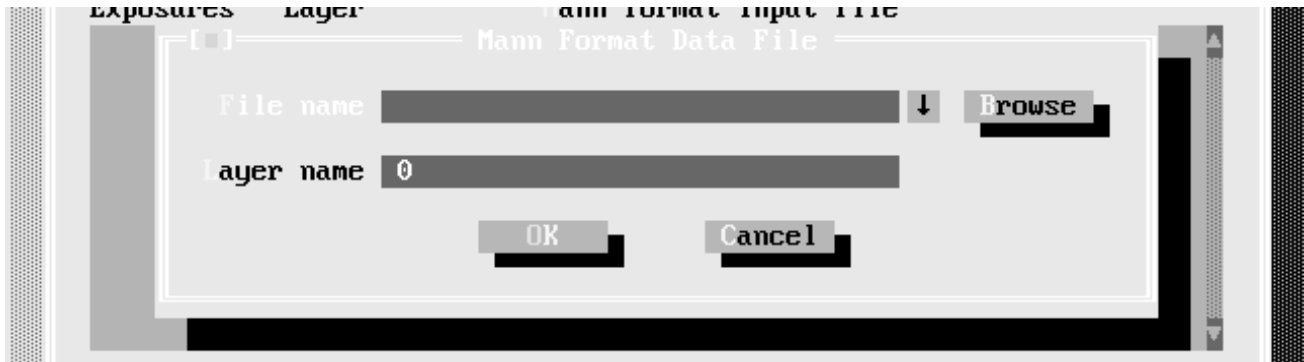
Each exposure in each of the Mann format files appearing in the file list box will be converted to an aperture block and written to the DXF file whose name appears in the DXF file name box. The block will appear on a DXF drawing layer, with the layer name chosen by the user. An exposure counter will be updated for each Mann format file as the conversion is carried out. The conversion can be interrupted at any time by pressing ESC .

Mann format file names can be added to or deleted from the file list using the **[Add]**, **[Rem]** and **[Sel]** buttons . A highlighting bar can be moved through the list using either the scroll bar or the cursor keys. The file name and layer name information for the currently highlighted item in the list can be changed by selecting the item.

Pressing the **[Options]** button provides access to the Mann to DXF conversion setup dialogue (see Figure C.4). Pressing the **[Start]** button will begin the Mann to DXF conversion process. Pressing the **[Done]** button will close and remove the Mann to DXF conversion dialogue box.

Pressing **[Rem]** (or ⎡DEL⎤) will remove the currently highlighted file from the list of files. Pressing **[Add]** (or ⎡INS⎤) will bring up a file selection dialogue. The user can then select a Mann format file for conversion, and the layer in the DXF drawing file where the exposures are to be stored.

Pressing **[Sel]** (or ⎡ENTER⎤) will bring up the same file selection dialogue as **[Add]**, showing the name and associated DXF layer for the currently highlighted item in the file list. Changes can then be made to the file and/or the layer information.

Each exposure in the Mann format file with the selected **File name** will be converted to a DXF aperture block and each DXF block will appear on the DXF layer **Layer name**.

Pressing the **[Browse]** button will bring up a standard file selection dialogue box (see Section I.4.3) with which the user can locate a Mann format file for conversion.

Pressing the **[OK]** button will accept the current file name and layer name settings and enter the file into the list. The selection dialogue box will be closed.

The default layer name is just the number of the file in the list of files minus 1. e.g. the first file chosen will appear on DXF layer '0', the second on layer '1', the third on layer '2' etc..

C.13 Sort/Verify│Sort...
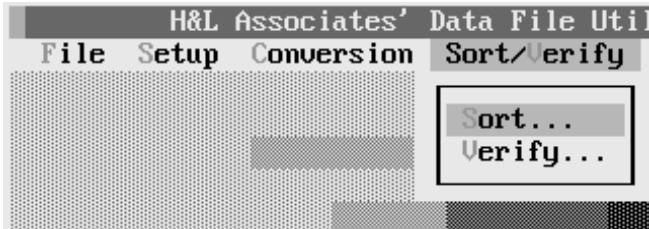
This command will invoke a Mann format file sorting dialogue box. All the exposures in a file will be sorted based on their X and Y positions and then written to an output file.

The Data Sorting user dialogue allows the user to locate and select the Mann format file to be sorted. Once selected, the sorting will begin when the **[Start]** button is pressed and finish when the sorting is complete, or the user interrupts the process by pressing ⌷ESC⌷ .
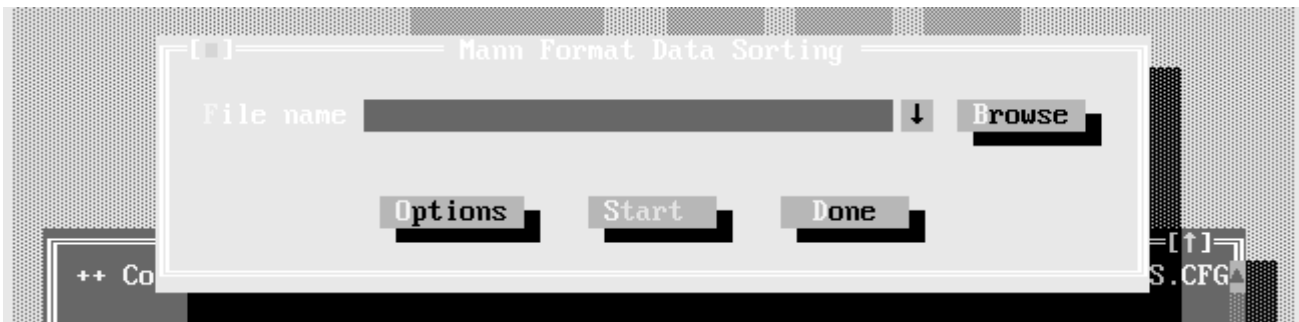
Figure C.10 : Mann Data Sorting Dialogue

A sorted file will be created with the same name as the input file, except with a '.SRT' extension. For example, if the input file name is C:\EXAMPLE\FILE1.M30, then the output file created will be named C:\EXAMPLE\FILE1.SRT. For the special case of the input file having an extension of .Lxx, where xx is a number between 00 and 99, the sorted output file extension will be .Sxx e.g. sorting FILE1.L03 produces an output file FILE1.S03.

The user enters the name of the Mann format file to be sorted in the **File name** input line.

Pressing the **[Browse]** button will bring up a standard file selection dialogue box (see Section I.4.3) with which the user can locate a Mann format file for sorting. Pressing the **[Options]** button gives the user access to the Sort configuration (see C.7). The user can select the kind of sorting to be performed on the Mann format input file.

Pressing the **[Start]** button will begin the sorting process. The sort can be interrupted at any time by pressing ⌷ESC⌷ . Pressing the **[Done]** button will close and remove the Mann file sort dialogue box.

C.14 Sort/Verify│Verify...
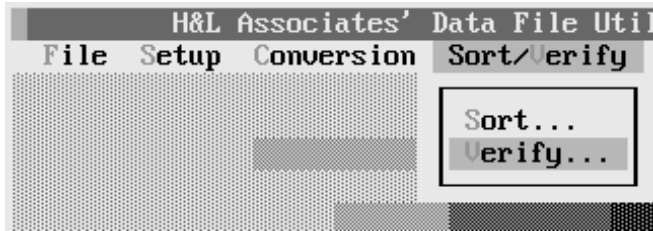
This command will invoke a Mann format file verification dialogue. All the exposures in a file will be checked against the limitations of the default pattern generator. Any problem exposures will be noted.

The Data Verification user dialogue allows the user to locate and select the Mann format file to be verified. Once selected, the verification will begin when the **[Start]** button is pressed. The user can interrupt the process by pressing the [ESC] .
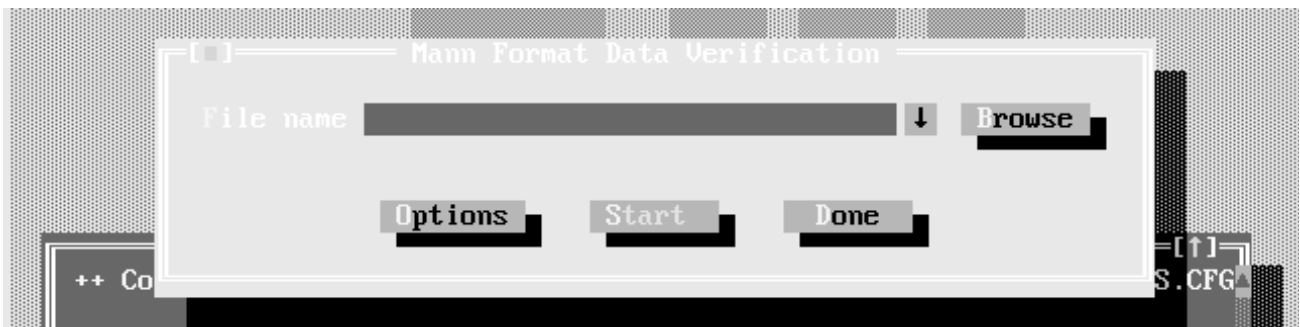
Figure C.11 : Mann Data Verification Dialogue

The data within the specified Mann format file will be checked for the following conditions:

● failure to comply with the Mann format for the default pattern generator (see Appendix II)
● axis settings (X, Y, H, W and/or A) beyond the range of the default pattern generator
● data with a resolution requirement beyond the capabilities of the default pattern generator

The user enters the name of the Mann format file to be verified in the **File name** input line. Pressing the **[Browse]** button will bring up a standard file selection dialogue box (see Section I.4.3) with which the user can locate a Mann format file for verification.

Pressing the **[Options]** button gives the user access to the Verify configuration user dialogue (see Figure C.6). The user can select the exposure range limits to be in effect during verification.

Pressing the **[Start]** will begin the verification process. The exposure checking can be interrupted at any time by pressing [ESC] . Pressing the **[Done]** button will close and remove the Mann file verification dialogue box.

C.15 Help│Using help

This command will bring up a help window describing how to use the online, context sensitive help system.

Context sensitive help is available at any time for this software by pressing [F1] . A scrollable help window will appear. It will contain help information as well as highlighted words or phrases referred to as 'help keywords' which will link to further help text.

Keyboard   ●   Press [Tab] (Tab) to move from one help keyword to another, then press [ENTER] to receive more specific help concerning that keyword. Press [SHIFT] [Tab] to move backwards from keyword to keyword.

Mouse   ●   Double-click on a help keyword to get more help concerning that keyword.

Press [ESC] or mouse click the upper left corner of the help window in order to dispose of the help screen

C.16 Help│Contents
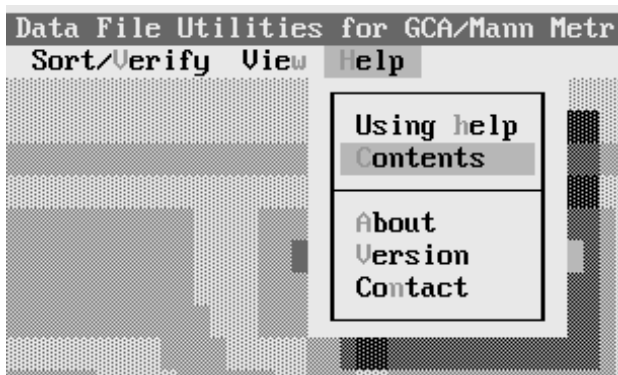
This command will bring up a help window containing a list of help topics from which the user can choose to get further help.

C.17 Help│About
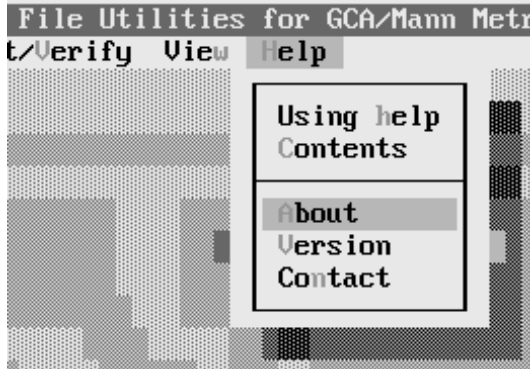
This command will bring up a simple description of the programme. Press [ENTER] to acknowledge this information and close the dialogue box.

C.18 Help│Version
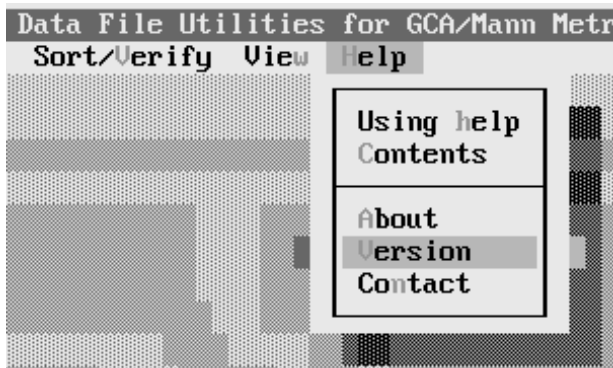
This command will provide information on the current version of the programme. Press [ENTER] to acknowledge this information and close the dialogue box.

C.19 Help│Contacts
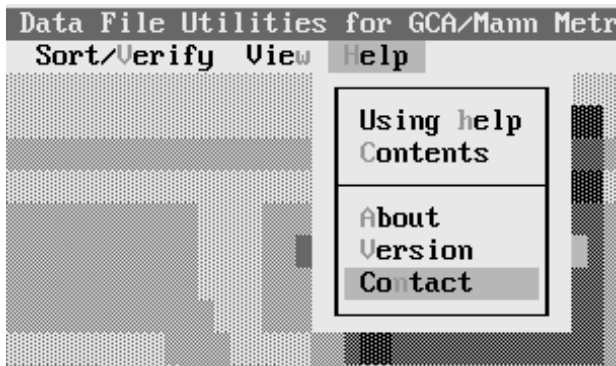
This command will provide the user with information about who to contact for further help or information concerning this software. Press [ENTER] to acknowledge this information and close the dialogue box.

Section D - Mann Format Data Viewer

D.1 Introduction

The **UPGVIEW** product is an optional feature of the **UPGUTILS Mann Format Data Conversion Tools**. UPGVIEW allows the user to closely examine the exposure data in one or more Mann format files without actually creating a photomask.

The programme has the following major features :

- support for CGA, Hercules monochrome, EGA/VGA and VESA video graphics

- the ability to ZOOM any portion of the display, up to a factor of 1,000,000 times

- the ability to PAN to any portion of the display using an on-screen cursor to specify the centre of the display area

- mouse support for cursor motion. Left and right mouse buttons will **Redraw** and **Zoom** the display respectively

- X-Y positions can be displayed in **Absolute** or **Relative** pattern generator units so that measurements of exposures can be made

NOTE:

If running UPGUTILS in a DOS window (CMD.EXE) under Windows NT/XP, the user will have to specify the **/v** option on the command line. This forces the use of 640x480 graphics mode, one of the few graphics modes properly supported by the Windows XP NTVM (NT Virtual Machine).

D.2 Viewer Summary

In order to graphically view one or more Mann format exposure files, the user will usually perform the following steps:
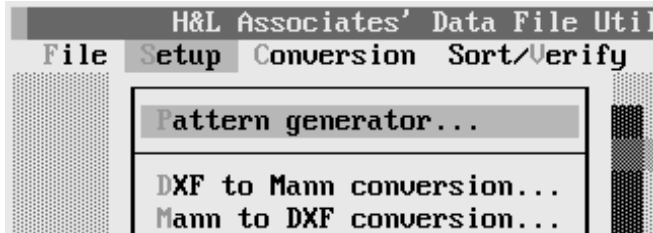
Select a target pattern generator with the user dialogue that appears for this command. Mann data files to be viewed must all be formatted for this pattern generator.
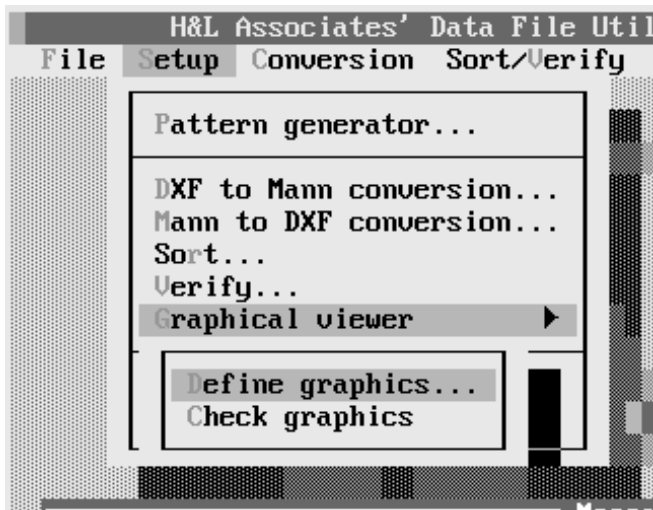
Set the desired graphics mode if the default mode is not suitable. A sample of the chosen mode can be viewed by selecting **Check_graphics** from the menu.

At startup, a graphics mode will automatically be chosen based on the highest resolution capabilities of the user's video graphics hardware. It is possible that the monitor attached to the user's system isn't capable of displaying this resolution so a lesser resolution may be chosen. The video drivers used with this software are capable of recognising and using CGA, EGA, VGA, Monochrome and VESA (16 colours) compatible video hardware.

The sample graphics mode display of **Figure D.1** is available to show the resolution that will be used for displaying exposures. The sample screen also shows the examples of each of the fill patterns available for filled exposures.
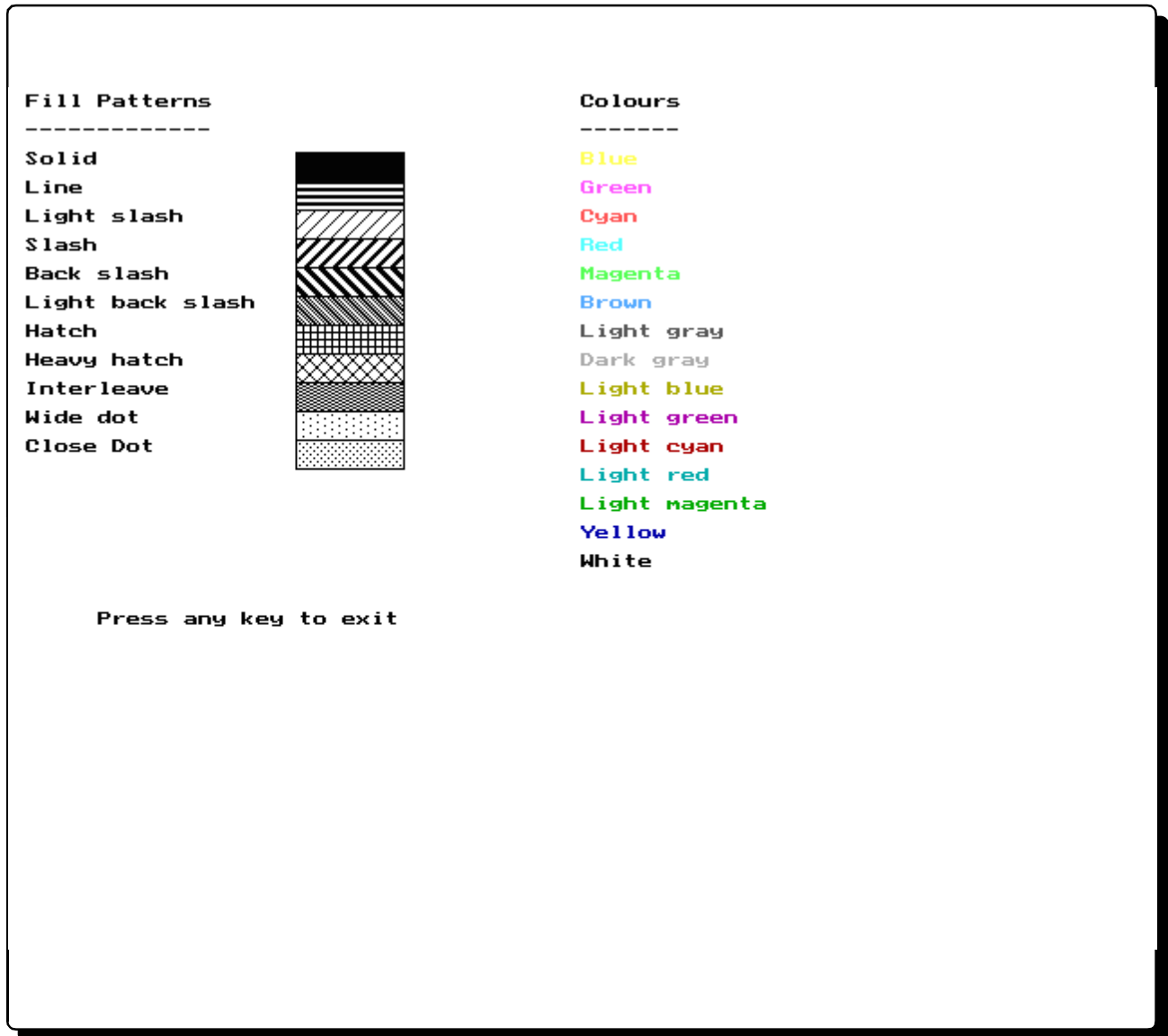
Figure D.1 : Sample Video Mode Screen

Where VESA compatible hardware is installed, the user may choose to force the use of the faster VGA mode by specifying the option **/v** on the command line e.g. c>**upgutils /v**

Enter the names of Mann format data files into a list of files. A user dialogue window appears for this command.

If a DXF to Mann conversion has recently been performed, then the names of the Mann files generated by this conversion will have already been entered into this list.
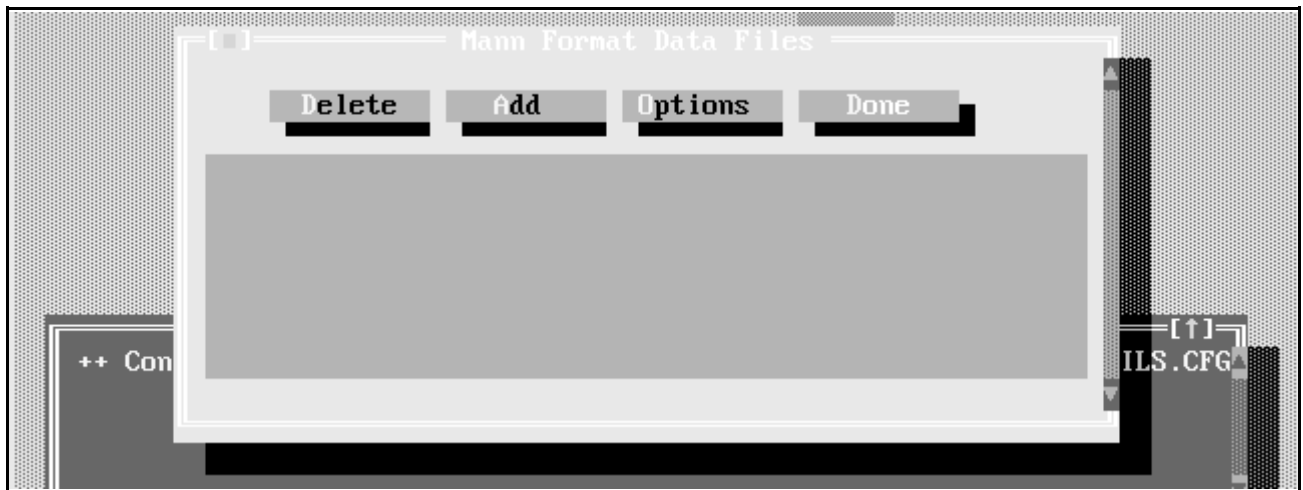
Figure D.2 : Mann Data File Selection Dialogue

Press the **[Add]** button (or INS) to add a file name to the file list. A standard file locator dialogue will appear for identifying the desired file. Press the **[Delete]** button (or DEL) to remove the highlighted file from the list.

Once the file name appears in the list, press the **[Options]** button (or press ENTER or double-click on the file name). The user will now have a choice of colours and fill patterns to be used when displaying this file's exposures. Repeat the process of entering file names and setting colours and fill patterns until all files appear in the list.
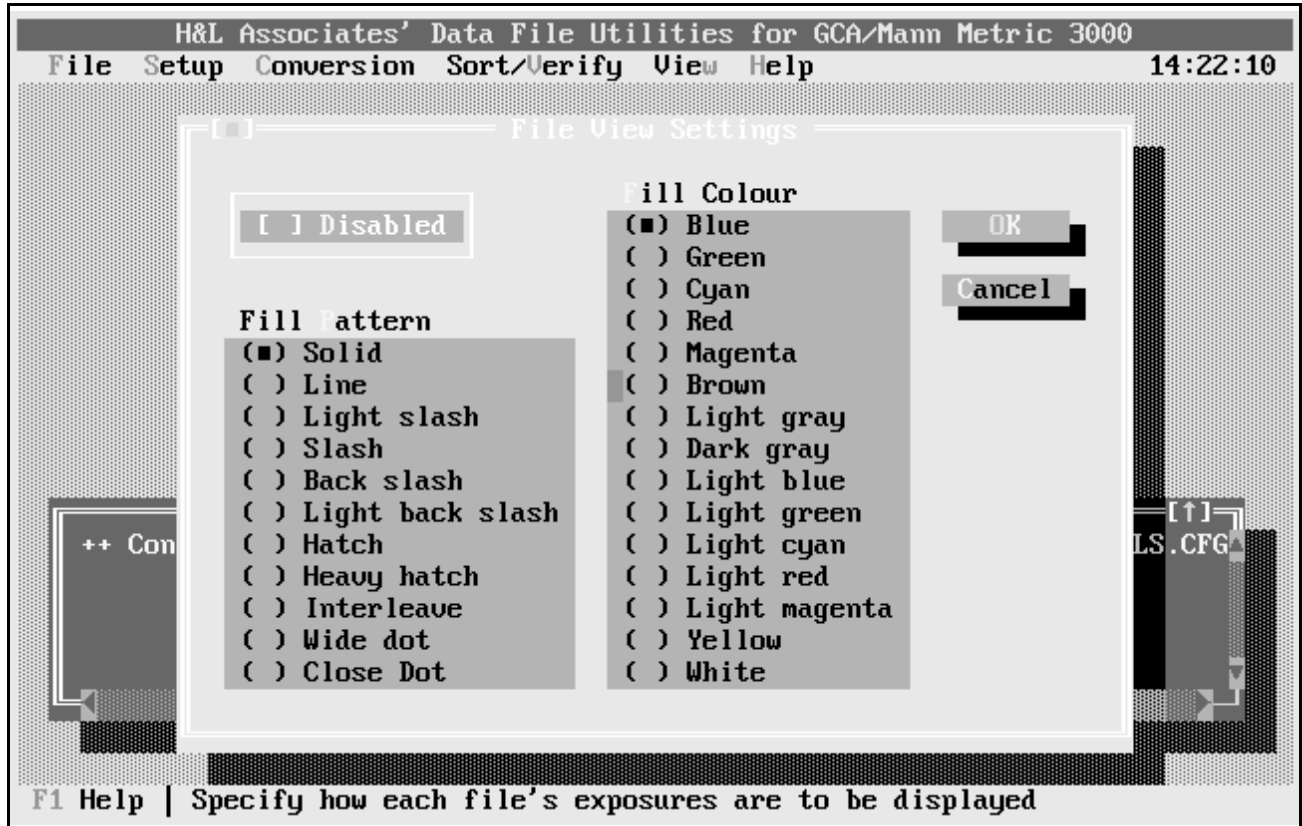
Figure D.3 : View File Settings Dialogue

Press the **[Done]** button to close the file entry dialogue. A check mark (√) beside the file name indicates that the data in the file will be included for viewing. For the currently highlighted file, pressing the right mouse button (or the spacebar) will toggle this check mark on or off.

Select this menu command to view the files.

The display will switch to graphics mode and the exposures in all enabled files will be drawn on the screen.

D.3 Graphics Mode

Once in graphics mode, the user's screen will appear as shown in **Figure D.4**.
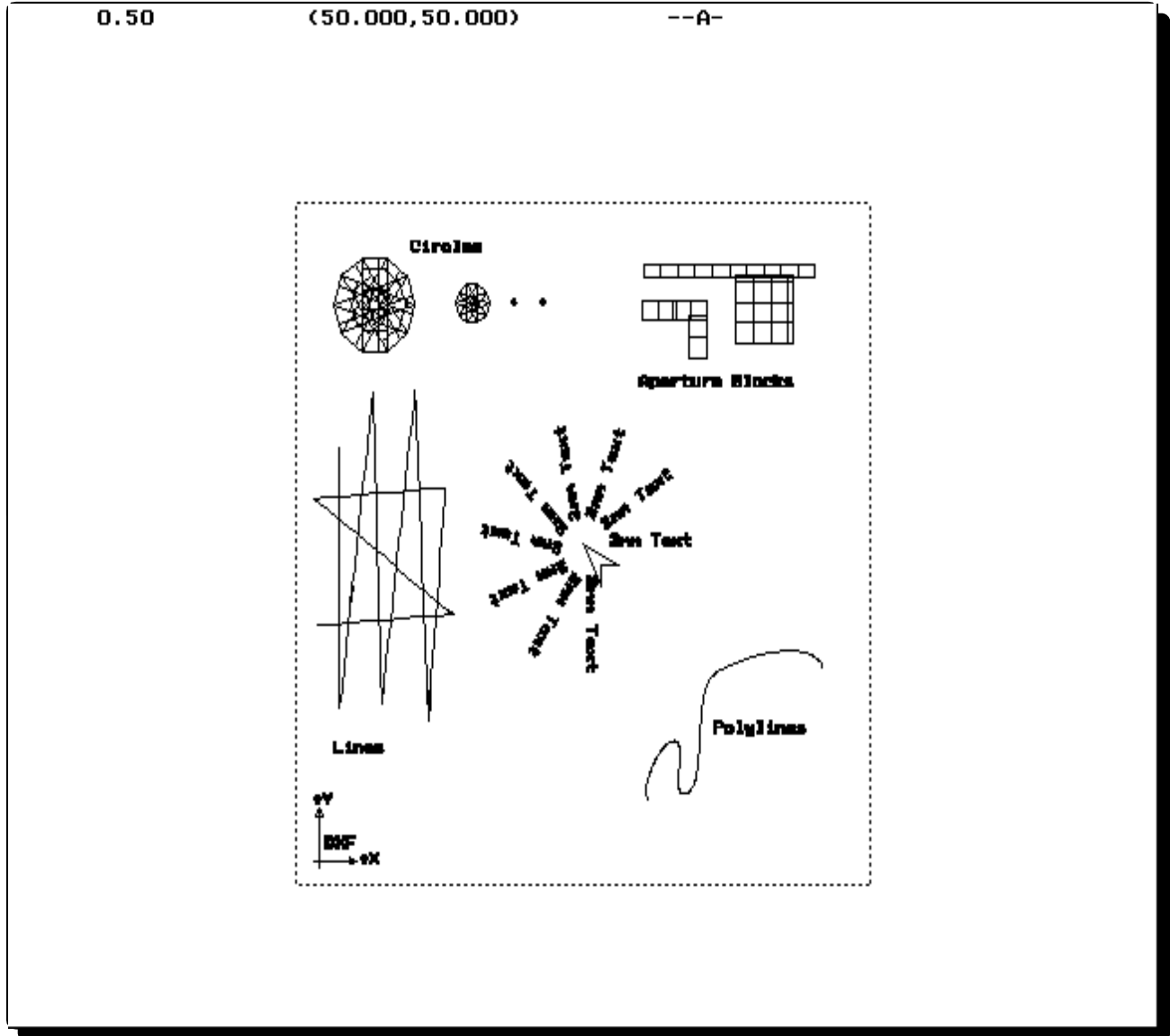
Figure D.4 : Exposure Data View Screen

An arrow shaped cursor appears in the centre of the screen. The position of this cursor will be used as the centre of the view for all operations that involve redrawing the screen.

The current zoom factor appears in the upper left corner and represents a multiplier applied to all exposures before displaying them on the screen. The larger this number, the higher the magnification applied to the exposures. At any time, the numeric keys (0..9), as well as the period and backspace keys can be used to enter or modify the current zoom factor. Pressing ENTER will cause the current zoom factor to be applied to the view.

The position of the tip of the arrow-shaped cursor (in pattern generator units) is displayed next to the zoom factor. The position will be in millimetres (mm) for metric data and inches (") for English data. The cursor position is constantly updated as the cursor is moved, either through moving the mouse or certain keys as follows:

Key	Cursor motion
↓	down one pixel
↑	up one pixel
→	right 1 pixel
←	left 1 pixel
PG DN	down 10 pixels
PG UP	up 10 pixels
CTRL →	right 10 pixels
CTRL ←	left 10 pixels
HOME	to left side
CTRL PG UP	to top
END	to right side
CTRL PG DN	to bottom

The status of various display options is shown in the upper right corner of the display. These options can be toggled on or off by using the commands shown below. One or more options can be in effect at any time.

Command	Description	Status
[A]	toggle between Absolute and relative coordinate display. In relative mode, the mouse cusor position, when A is pressed, becomes the new origin for the view.	--A- --△-
[M]	mirror the image about the vertical axis	-M--
[R]	rotate the image counter clockwise (CCW) by 90° degrees	---9
[S]	turn on the fill pattern for exposures	S---

The following additional commands will also be recognised when in graphics mode

[+]	zoom the current image by a factor of 2
[−]	zoom the current image by a factor of 1/2
[X]	return to the text mode desktop display
[ESC]	return to the text mode desktop display
]	show the name and colour of the next Mann format file in the list
[	show the name and colour of the previous Mann format file in the list
left mouse button	redraw the screen centered about the mouse cursor position
right mouse button	zoom the current view by a factor of 2
[SHIFT] +right mouse button	zoom the current view by a factor of 1/2

Appendix I - Standard User Interface

I.1 Introduction

H&L Associates' software written for PC/MS-DOS has a text-based user interface (as opposed to a Graphical User Interface or GUI). The interface supports the standard GUI features including mouse operations, pull-down menus, dialogue boxes, scrolling windows and input fields. A typical user screen is shown in Figure III.1.
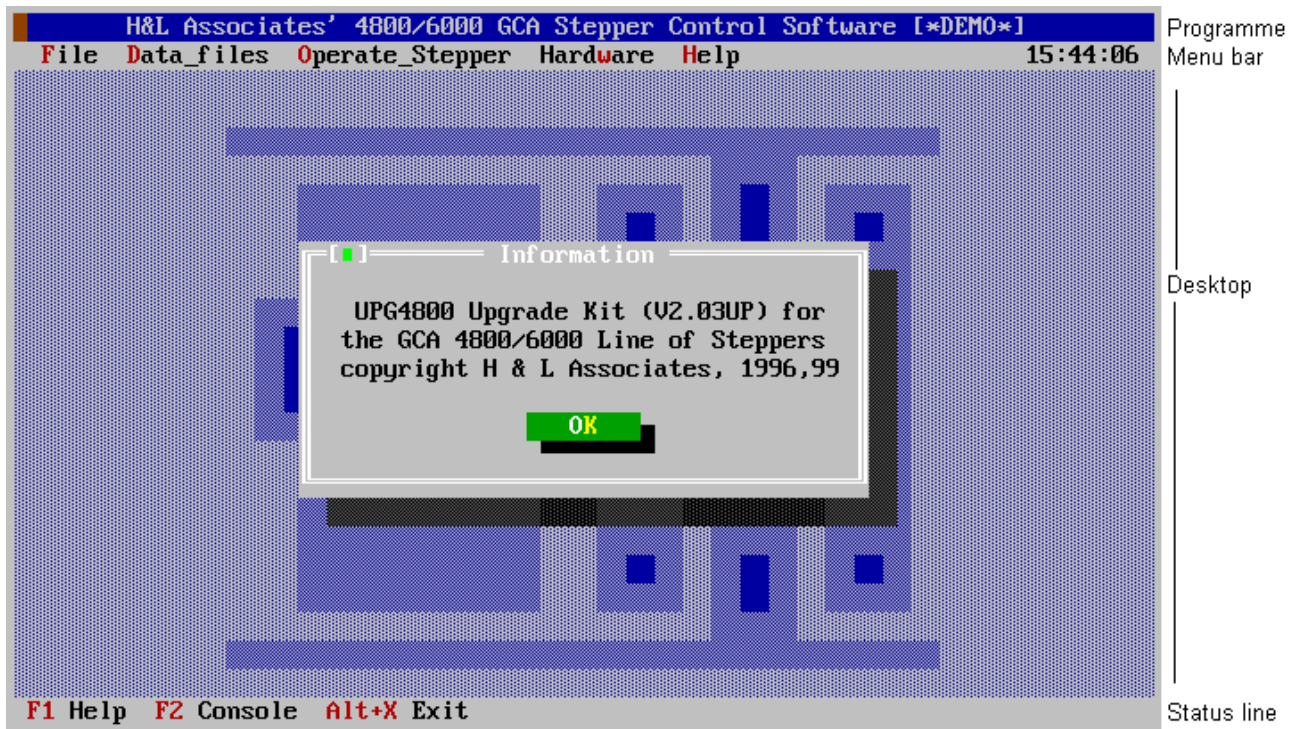

Figure I.1 : Typical User Interface Screen

There are four components to the user interface: a Programme Title, a Menu Bar, a Desktop and a Status Line. The function and operation of each of these components is described in the following sections.

I.2 Programme Title

The title of the programme appears in the top line of the user's screen. This title usually remains constant, but may change as certain settings in the programme are changed e.g. in some utility software, a change in the default pattern generator will be reflected in the programme title.

I.3 Menu Bar

The Menu Bar provides the primary access to all the menu commands. When the Menu Bar is active, a menu title will be highlighted as shown in Figure III.2. This is the currently selected menu.

Figure I.2 : Menu Bar and Menu Command

Choosing a menu command using only the keyboard involves the following steps:

①   Select a menu
       ☞   Press F10 to activate the Menu Bar

       ☞   Use the arrow keys to move the highlighting bar to the desired menu name, then press ENTER . As a shortcut for this step, press the highlighted letter in the menu title. For example, from the Menu Bar, press F to display the File menu.

       Alternatively, without first activating the Menu Bar:
       ☞   Press ALT and the highlighted letter to display the desired menu. For example, press ALT F to display the File menu.

②   Select a menu command
       ☞   Use the arrow keys to choose the desired menu command, then press ENTER . The command will be carried out, or a dialogue box or another menu will be displayed.

       Alternatively, without using the arrow keys:
       ☞   Press the highlighted letter of the command in order to choose it once the menu is displayed. For example, from the Files menu, press X to terminate the programme.

A menu command may also have a hot key assigned to it. The hot key will be shown next to the command in the menu. Pressing this key or key combination will invoke the command without displaying the menu first. For example, pressing ALT X (Exit) will cause the programme to terminate immediately.

Choosing a menu command using the left mouse button involves the following steps:

☞   Click on the desired menu title to display the menu
☞   Click on the desired command

Alternatively
☞   Click and hold the left mouse button on the desired menu title, drag the cursor to the
          desired menu command, and then release the mouse button.

If a menu command is followed by an ellipsis (...), choosing the command will display a user dialogue window. If the command is followed by an arrow (▸), the command will invoke another menu. A command without either an ellipsis or an arrow will be executed immediately.

Menu commands that appear dim (or 'grayed' out) are disabled, most likely because the command has no logical function in the current context.

I.4 Desktop

Windows and dialogue boxes are areas of the screen that interact with the user. They appear in the large central portion of the screen called the desktop.

I.4.1 Windows

A window is a bordered screen area that may be moved, resized, zoomed and/or closed. The contents of the window can be scrolled horizontally or vertically through the use of scroll bars. If the window also contains buttons, check boxes or other user controls, then it is referred to as a user dialogue.

Only one window can be active at any time and all user keyboard and mouse actions will apply to this window. If windows overlap, the active window is always the topmost one. The active window always has a double-lined border around it, and one or more of the following elements, as shown in Figure III.3: a title bar, a resize corner, a close indicator, a zoom indicator and scroll bars.
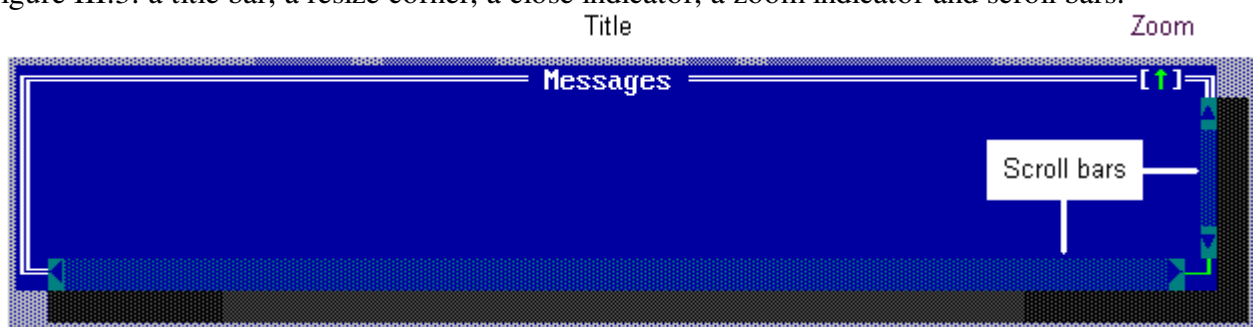
Figure I.3 : Desktop Window Elements

To move a window

Keyboard	☞	Press ⎣CTRL⎦ ⎣F5⎦ , then use the arrow keys to move the window. Press ⎣ENTER⎦ when the window is in the desired position.
Mouse	☞	Drag (left button click and hold) the window's title bar to the desired position, then release the mouse button.

To close a window

Keyboard	☞	Press ⎣ESC⎦
or	☞	Press ⎣ALT⎦ ⎣F3⎦
Mouse	☞	Mouse click on the upper left corner =[■]= of the window

To zoom a window

A window on the desktop can be zoomed (made to fill most of the screen) only if there is a zoom indicator =[↑]= in the upper right corner of the window.

Keyboard	☞	Press ⎣F5⎦ to alternate between a zoomed and unzoomed state.
Mouse	☞	Mouse click on the upper right corner =[↑]= of the window
or	☞	Double click on the window title bar

To resize a window

A window on the desktop can be resized only if there is a resize indicator (⌐) in the lower right corner.

Keyboard	☞	Press ⎣CTRL⎦ ⎣F5⎦ , hold down ⎣SHIFT⎦ and then use the arrow keys to change the size of the window. Press ⎣ENTER⎦ when the window has the desired size.
Mouse	☞	Click on the lower right corner of the window, hold down the mouse button, drag the corner to the desired window size and then release the mouse button.

To scroll a window

The contents of a window (such as a help or message window) are scrollable only if scroll bars appear along the edge of the window (see Figure III.4).

Keyboard	☞	Press ⎣PG UP⎦ , ⎣PG DN⎦ , ⎣↑⎦ or ⎣↓⎦ to scroll vertically. Press ⎣HOME⎦ , ⎣END⎦ , ⎣→⎦ or ⎣←⎦ to scroll horizontally.
Mouse	☞	use the vertical or horizontal scroll bars as shown in Figure III.4
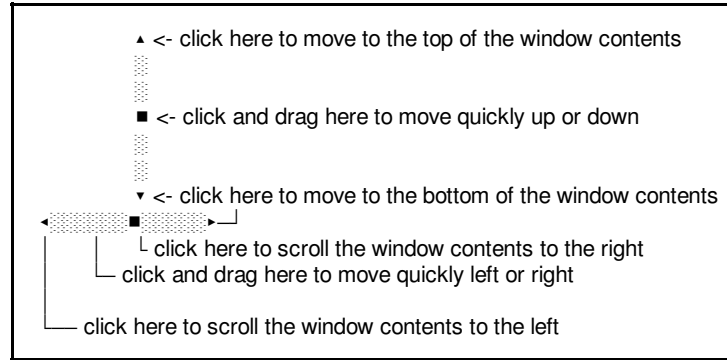
Figure I.4 : Window Scroll Bars

I.4.2 Dialogue Boxes

A user dialogue box is a special kind of window and a convenient way for the user to view and set multiple options and to input text or numbers. There are five basic types of onscreen controls or groups (see Figure II.5) which may be found in a dialogue box: radio-buttons, check boxes, action buttons, input lines and list boxes.
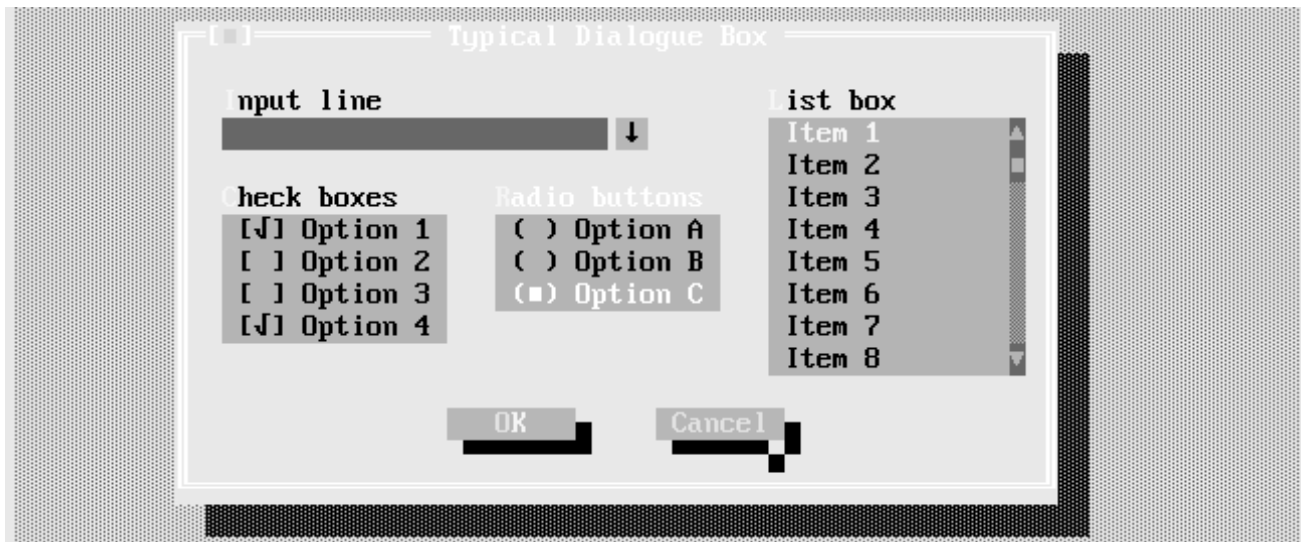
Figure I.5 : Dialogue Box Controls

The currently selected group (or item in the group) will be shown as highlighted. A group can be selected by:

Keyboard	☞	using ⑤ to move forward from one group to another, or ⑤HIFT ⑤ to move backwards. Use ⑤ and ⑤ to move from one item to another in the group.
Mouse	☞	mouse clicking on the group, or an item in the group

I.4.2.1   Input Lines

An input line allows the user to enter numbers or text into the programme. Most basic text editing keys (⬅ ➡ ⬆ ⬇ HOME END and INS) can be used when entering information. The line's contents will automatically scroll if the typed characters exceed the length of the input box. Arrowheads (◄ and ►) will appear if the line holds more information than can be displayed, and mouse clicking on these arrowheads will scroll the information left or right.

If an input line has a history icon (↓) to its right, then a history list is associated with the line. Pressing ↓ or mouse clicking on the icon will bring up a list of the last entries made in the input line. Use the cursor keys to move the highlighting bar to the desired entry and then press ENTER to copy the list item into the input line. Double clicking on the desired list item will also copy it into the input line. Pressing ESC will close the history list without making a selection.

I.4.2.2   Check Boxes

A check box is indicated by a pair of square brackets [ ] and is used to turn a given feature on or off. Any number of check boxes can be checked at any time. A √ appears between the square brackets (e.g. [√]) to show that the option is on, otherwise a blank will show that the option is off. In order to toggle the state of a check box:

Keyboard	☞	select the group as usual using ⬚. If the check box is part of a cluster, use the arrow keys to highlight the desired check box. Press SPACE
or	☞	type the highlighted letter in the text of the check box
Mouse	☞	click on the box, or its associated text with the left mouse button

I.4.2.3   Radio-buttons

Radio-buttons are represented by a pair of round brackets ( ) and are similar to check boxes except that they represent mutually exclusive choices. For this reason, radio-buttons will always appear in groups of at least two, and only one radio-button can be on, as indicated by a ■ between the brackets (e.g. (■)). In order to chose a radio-button:

Keyboard	☞	select the group as usual using ⬚. Use the arrow keys to choose a particular radio-button, then press ⬚ to move to the next control box.
or	☞	type the highlighted letter in the text of the radio-button
Mouse	☞	click on the radio-button, or its associated text with the left mouse button

I.4.2.4   List Boxes

A list box allows the user to scroll through and select an item from a variable length list, without leaving the dialogue box. Once a list box is selected, the user can move the highlighting bar through the list by using the up/down arrow keys or the vertical scroll bar attached to the list.

For some applications, the list box will show items that can be altered by the user. For example, highlighting an item in the list, and then pressing ENTER (or double clicking on an item in the list) may bring up another user dialogue to change the settings of the list item.

I.4.2.5   Action Buttons

Pressing an action button will cause the action described in the text of the button. Most user dialogue boxes have two standard action buttons: [OK] and [Cancel].

Choosing [OK] causes the current settings and options in the dialogue box to be accepted and the window to be closed. Choosing [Cancel] causes all current settings to be ignored and the window to be closed. Clicking the Close icon in the upper left corner of the window, or pressing ESC will have the same effect as [Cancel], even if no Cancel button appears.

An action button is pressed by:

Keyboard	☞	pressing the highlighted letter in the text on the button. For example, pressing K selects the OK button.
or	☞	using ⬐ to select the desired button, then pressing ENTER to choose it.
Mouse	☞	mouse clicking on the button.

I.4.3 File Location Dialogue

The dialogue box used to locate a file is common in most applications and has a standard form as shown in Figure III.6.

Figure I.6 : Standard File Location Dialogue

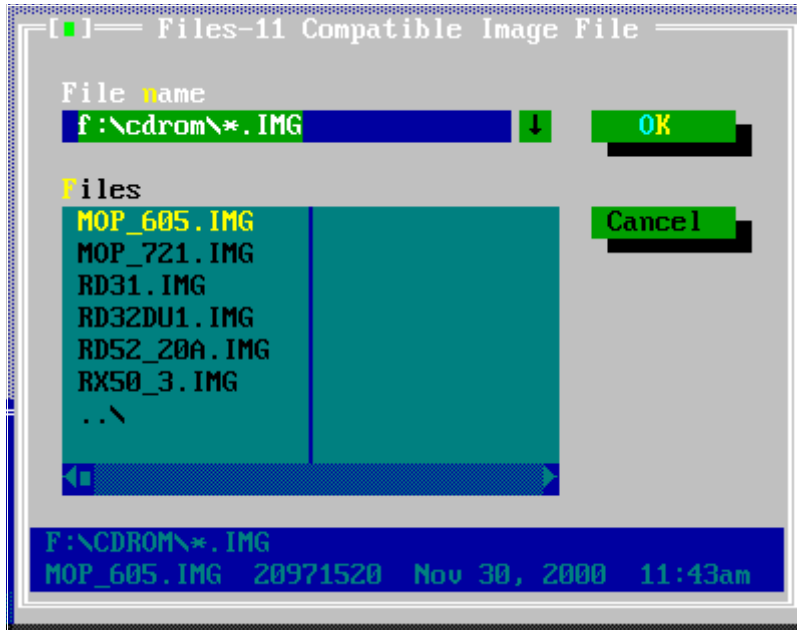The user enters the name of the file to be read or created, or the mask to use as a filter for the list box (e.g. *.* or *.L00), into the File Name box.

The Files box lists the names of files in the current directory that match the mask in the File name box, plus the parent directory and all subdirectories. A file name may be selected by double clicking on the name or by using the cursor keys to highlight the desired file, and then pressing ⏎ENTER .

Once selected from the file list, the file name will be copied into the File Name box. Pressing the [OK] button will close the dialogue provided that a valid DOS file name appears in the File Name box.

The bottom of the dialogue box contains a file information panel, showing the highlighted file's name, size, time, date and the full DOS path name.

I.5 Status Line

The status line appears at the bottom of the screen and has the following purposes:

- it reminds the user of basic keystrokes and hot keys applicable to the current window
- it presents hot keys which can be mouse clicked to carry out some action instead of choosing a menu command or pressing the actual hot key e.g. pressing F1 or mouse clicking on the words *F1 Help* will bring up the context sensitive help system.
- it shows progress messages
- it offers one-line descriptions (hints) of any selected menu command or dialogue window item.

Appendix II - DXF Pattern Creation Example

The procedure of creating a photomask will be the same for most CADD packages. This procedure is for AutoCAD and involves the following steps :

- Define the APERTURE block

    The Aperture Block is a unit square which must be defined before using it as a building block in a photomask pattern. The procedure is basically the same for most CADD software:

    - set the GRID and SNAP values to 0.25. Set the SNAP feature ON. It is important that the aperture block be exactly a unit square.

    - draw four lines between the following X-Y coordinates to create the unit square: (0,0) to (0,1) to (1,1) to (1,0) to (0,0)

    - in order to more easily handle the block, place a POINT at the centre point (0.5,0.5).

    - In AutoCAD, use the BLOCK command to place a window around these four lines and point. When prompted for an insertion point, specify the centre of the square (0.5,0.5). A similar operation, called COMPONENT CREATE is available under GENERIC CADD, and most CADD packages have a block creation feature.

    - the default name for this block is APERTURE, but the user may name it something else, so long as that name appears in the Exposure Names List (see Section C.11).

    In most CADD software, the block can be selected and moved by pointing to any part of it, but it is recommended that the centre point be used as a handle. This will ensure that the centre of an exposure will lie on a point within the resolution of the default pattern generator. Once defined, the aperture block can be scaled in the X and Y directions and rotated to represent any rectangular exposure that a photomask designer might want to make with a pattern generator.

- Set the SNAP and GRID parameters to the resolution of the default pattern generator
    e.g.   0.00025" in the English Special 1600A/2600
            0.001 mm for the Metric Special 3000

- Turn the SNAP and GRID features ON.

- Set the number of decimal places required for the display of X and Y coordinate data. This will be dictated by the resolution of the target pattern generator e.g. 3 decimal places for a metric 3000, 5 for an English 1600A. Set the number of decimal places used for displaying angles to one (1).

- Using a DOTTED line, draw a square to mark the limits of the photomask slide (typically 4" X 4" or 100mm X 100mm). The advantage to doing this is that a ZOOM ALL of the pattern will always show the exposure slide filling the drawing area.

- Use the INSERT command to place an APERTURE. Depending on the current ZOOM level, you can either interactively place the APERTURE, or you can specify an actual X-Y coordinate. AutoCAD has a DRAG feature so that blocks can be actively scaled and rotated. If this feature is used, remember that the angle resolution should match that of the user's pattern generator. If a DRAG feature is not used then enter the X scaling factor (corresponding to the W aperture dimension), the Y scaling factor (corresponding to the H aperture dimension) and the desired angle.

The placement of an APERTURE is now complete. Any of the editing features (move, copy, rotate etc.) can be used to construct a pattern. Note that some commands (array, mirror) may not SNAP objects to the resolution of the pattern generator.

LINEs can be used as wires to connect aperture blocks. POLYLINEs, since they have a variable width, can be used to make long, connected exposures all of the same width. CIRCLEs can be used as wire bonding pads.

The sample drawing of **Figure III.1** shows the different entities that can be used to create a photomask and that will be recognised by the DXF to Mann conversion software. Figure **Figure III.2** shows the results of the DXF to Mann conversion process on this drawing, using a metric Mann 3000 as the target pattern generator and the default UPGUTILS.CFG file settings.
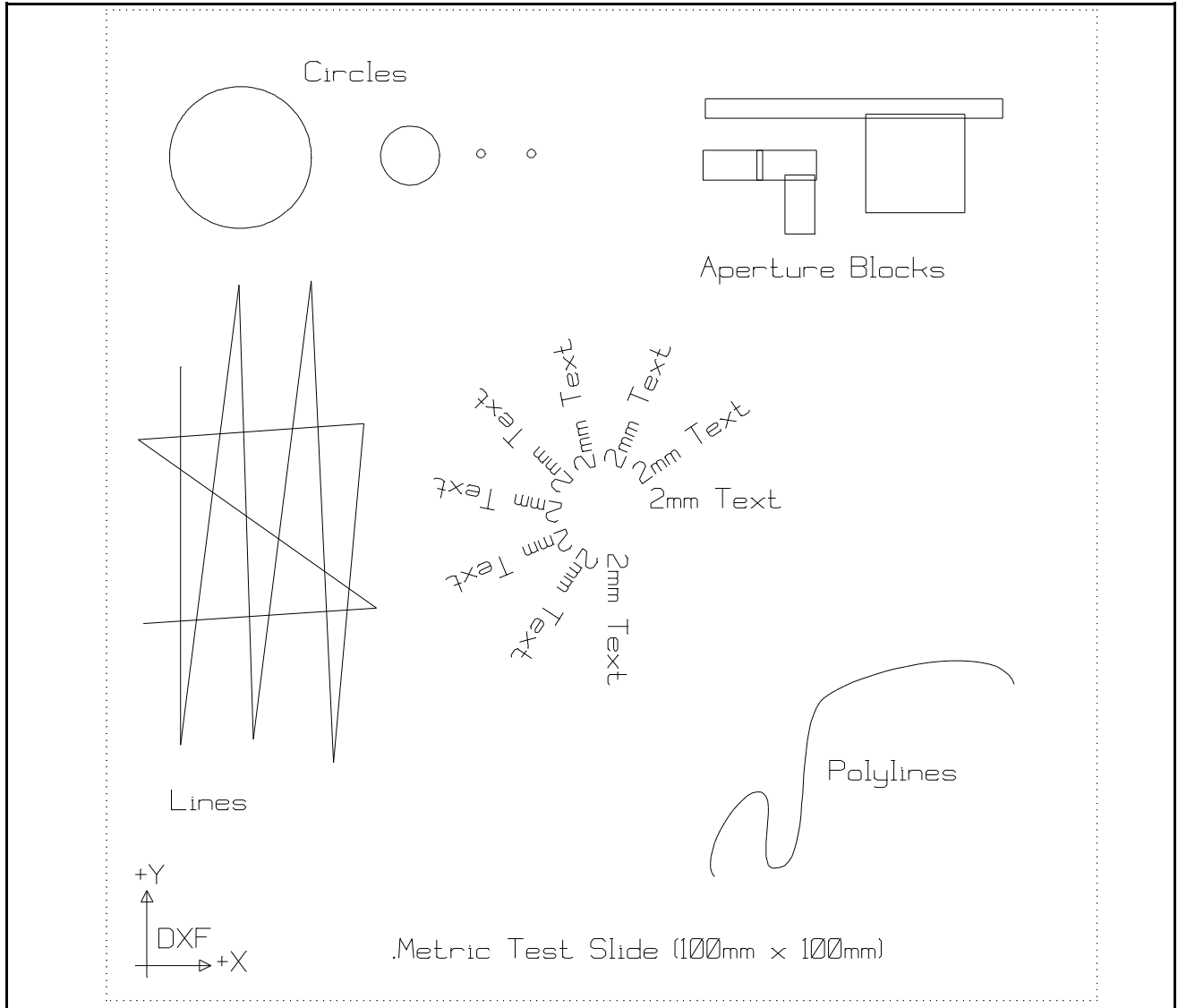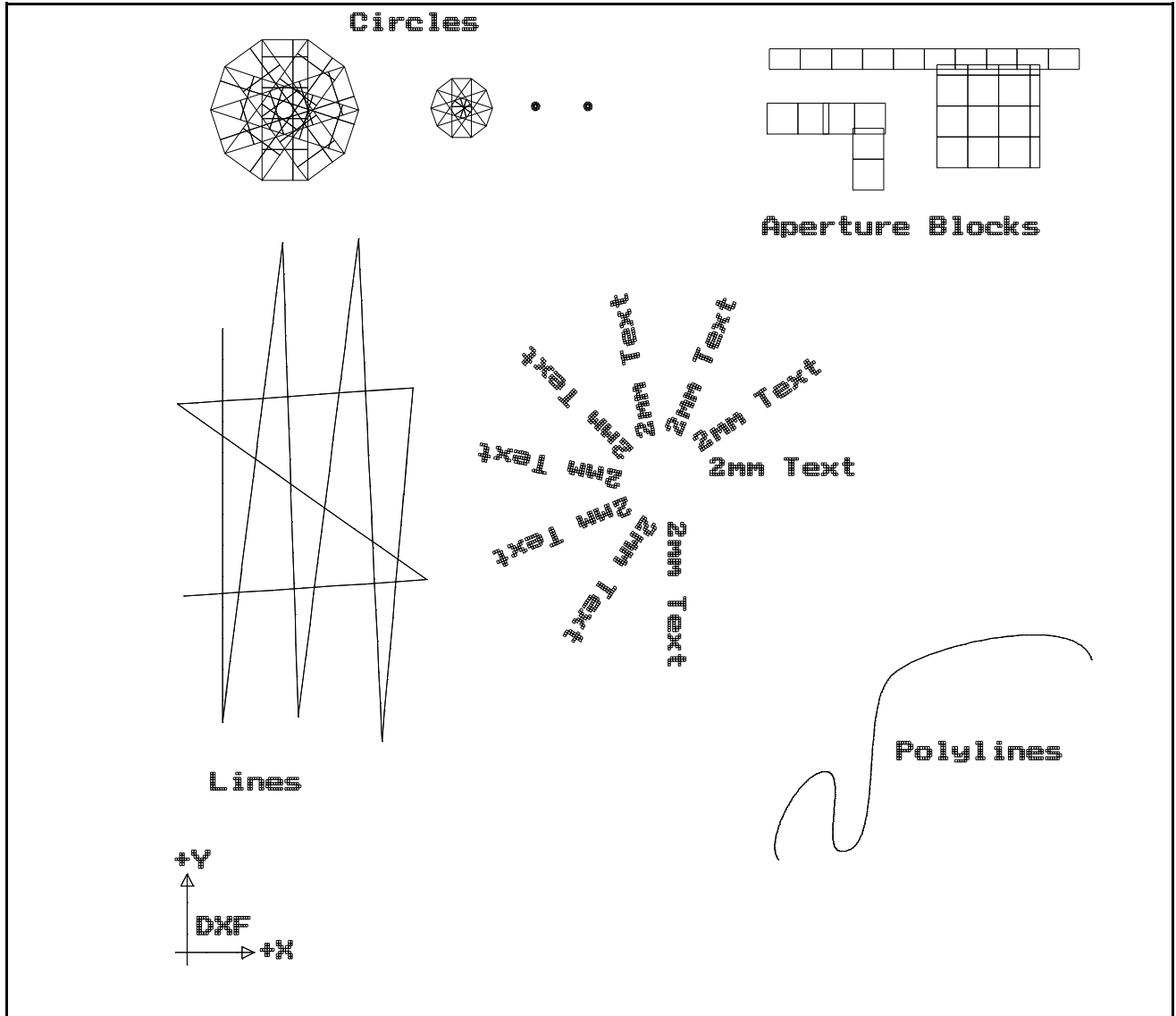
Figure III.1 : Sample DXF Photomask

Figure III.2 : Sample Mann Photomask Created from DXF File

The aperture blocks have been fractured into a series of adjacent, smaller exposures. The circles have been approximated by 10-sided regular polygons. Text has been converted to small exposures (text with a leading '.' character has not been converted). Lines and polylines have been converted into a series of thin, connected exposures.