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CAT MONITOR AND SUPPORT UTILITIES
USER GUIDE

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1. Introduction

This is the User Guide for the Primagraphics CAT Monitor and Support Utilities. It does not attempt to describe the CAT processor board or daughter boards themselves as these are described in the relevant technical manuals.

The CAT Monitor is the firmware supplied on all Primagraphics CAT processor cards. It is embedded in the top 256kbytes of the Flash memory on the card, and is automatically booted by the C80 processor at power-up and resets. The Monitor is responsible for testing and initialising the CAT card and any video display card that may be present.

The Monitor also provides the user with the capability of editing the contents of the CAT EERAM. This enables the video format and VME interface to be tailored to the specific requirements of an individual system.

The support utilities consist of host programs (and in some cases associated C80 programs) to download and execute COFF files (i.e. **catload**), to blow user programs into the Flash memory on the card (i.e. **catblow**), to extract information such as the size, date and name from COFF files (**coffinfo**) and so on.

The host utilities are supplied precompiled for standard VME Sparc hosts (such as the Force 5V). However, since not all VME systems would have such a host processor present, the source code to these utilities is also provided to enable them to be recompiled as required.

Also supplied as source code are various routines for retrieving the results of the Built In Self Test from CAT cards. These may be included in host based programs to allow the state of the target hardware to be checked before, or during, execution of the application.

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1.1 Installation

The support utilities are shipped in a compressed tar file named **cat_tar.Z**.

To install the software, copy the **cat_tar.Z** file to your intended installation directory and, in that directory, execute the following command:

```
uncompress -c cat_tar.Z | tar xvf -
```

This will uncompress the tar file and extract the software from it into the following directory structure:

```
CAT/                        - Base directory
        Config/             - Example EERAM contents files
        Man/                - Manual pages for host utilities
        README              - Release notes
        Source/             - The source code for the host utilities
        Utils/              - Utilities directory
                c8xflash.out - COFF file used for programming Flash memory
                sun4/       - Precompiled host utilities
```

You may wish to add the directory containing the utility executables to your path for ease of use in the future.

Also, you may wish to set the `CAT_DIR` environment variable so that COFF files may be easily located by the host utilities such as **catload** and **catblow**. See section 3.2 for more information regarding this.

Finally, the manual pages under the `Man` directory can be installed in the appropriate directories for your system to provide on-line documentation of host utilities. This can be done by executing the following command (you may need root permissions) in the **Man** directory:

```
make install
```


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2. The Monitor

The Monitor is the firmware supplied on all Primagraphics CAT processor cards. It is embedded in the top 256kbytes of the 1Mbyte of Flash memory when the cards are manufactured.

When the C80 executes its power-up/reset procedure it will boot this program from the image of Flash memory at the top of the CAT memory map (which is later disabled to allow a wider window onto the VME bus).

The Monitor then tests various components and interfaces on the CAT and display cards, and initialises them all for basic use, including the VME interface so that host computers may communicate with the card and download executables and data as required.

The CAT card contains a block of EERAM which stores various parameters to be used by the Monitor when initialising the CAT. These include the VME addresses (in both short [A16] and extended [A32] space) at which the CAT should appear, as well as the display format for which the video card should be initialised. If the contents of the EERAM are corrupted (automatically detected using checksums) then default values are used instead. It is possible to force the Monitor to ignore the contents of the EERAM and use default values instead. This is described in section 2.3.

The red LED on the front panel of the CAT comes on when the card is reset. If all the boot-up tests successfully pass, the Monitor will extinguish the LED. However, if any of them fail, the LED will be flashed continually.

Once the card is initialised, the Monitor then performs one of two actions. If the lower section of the Flash memory contains an embedded application program, and various conditions are satisfied (see section 2.2), then this embedded program is automatically booted.

Otherwise, the Monitor goes into a state in which it may accept commands from either the host utilities (e.g. to download an application program), or from a user communicating with it via a terminal attached to the serial connector (normally channel A) on the front panel of the CAT itself (e.g. to edit the EERAM contents).

Note that the monitor does not 'stay resident' when application programs are booted (either from Flash or from the host) - i.e. once an application program starts executing, the only way to get back to the Monitor is to reset the CAT.

The following sections describe how to communicate with the Monitor via a terminal, and how and when application programs are booted. Later chapters describe the operation of the host utilities themselves.

2.1 Terminal Connections

The CAT Monitor provides various functions (such as examining the state of the board, editing the EERAM and so on) through a series of menus available to a terminal connected to the serial I/O connector on the CAT front panel.

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To access the menus, connect a Terminal (or a PC or workstation with terminal emulation software) via an RS-232 cable to the front panel micro D-Type connector (usually to channel A although this may be changed to channel B as described in section 2.1.3). The terminal should be configured for 9600 Baud, 8 bits, no parity and 1 stop bit.

When the CAT is reset, the Monitor will output a series of diagnostic messages over the serial port before entering the Main Menu (assuming it is not booting an embedded application program - see section 2.2). Under normal conditions, the output should be similar to that shown in Appendix D although the exact output will depend upon the precise hardware present.

This Main Menu provides the capability to enter various sub-menus, or perform certain actions directly. Also, it supports most of the generic options available on all menus and sub-menus. Options from menus may be selected by typing the character for that option, followed by any arguments required, followed by 'return'. The generic options are:

.	Repeat the last action performed
?	Print the list of options provided by the current menu
q	Quit this sub-menu, returning to the parent menu (note that this option is not available from the Main Menu)

In general, an option selected with a capital letter takes the user into a sub-menu (e.g. 'V' for Video Setup, 'I' for VME Interface) whereas an option selected with a lower case letter actually performs an action.

Arguments which may take only a limited number of values are normally specified as either ranges or lists separated by slashes. For example, "0-3" means that the numbers zero to three (inclusive) are allowed as the argument. "r/d/c" means that the characters 'r', 'd' and 'c' are the only values allowed.

Arguments which require values with certain meanings are specified within angle-brackets - the required value should be substituted for the 'meaning'. Optional arguments are shown within square-brackets. Neither type of bracket should be entered by the user.

Hexadecimal numbers should be entered with a preceding '0x'.

For example, "e <addr>" indicates that an address is required, so the user should enter something like "e 0x1c800000" whereas "v [<format>]" indicates that an optional format number may be specified so the user could either enter "v" on it's own, or "v 0" to specify format 0.

If a comma is listed in the set of arguments then it should be entered by the user. For example, "s <width,height>" should lead the user to enter something along the lines of "s 1280,1024".

The EERAM is split into various sections, each of which has its own checksum. If this checksum is wrong for any particular section, then it is assumed that the entries in that section are corrupt, so as well as being ignored by the Monitor during initialisation, they cannot be edited until they have been reset to the default values. This may be done by selecting option 's' in the Test menu (which should be reached through the 'T' option from the Main Menu).

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When changing the contents of the EERAM, the operation of the board is not immediately affected. The changes will take effect when the board is next reset. You may make multiple changes before resetting the card if you wish.

In order to edit the EERAM, the hardware links must be set appropriately to enable writes to the EERAM. For details of the links on the CAT, please refer to Appendix B of this document, or to the Technical Manual for the CAT itself.

Each of the menus are described in detail in Appendix A. The following sub-sections describe how to perform the most commonly desired actions.

2.1.1 Changing the VME Settings

From the Main Menu, selecting option 'I' takes you into the VME Interface menu. From this menu, you may view and edit the EERAM entries that specify the way the VME interface will be initialised on reset.

The current VME settings may be viewed with the 'p' (print) option. This is done automatically when the VME Interface Menu is entered from the Main Menu. This will also inform you whether or not the CAT is set up as the VME Slot 1 Controller. If it is not the Slot 1 Controller, then some of the settings in EERAM will not make any difference to the operation of the board (although you may still edit them).

The VME settings may all be set to their default values by entering the following command:

```
d ALL
```

To change the VME addresses, simply use the 's' and 'e' options to set the Short and Extended Space addresses respectively.

The short address must be a hexadecimal value in the range 0x0000 to 0xff00 and must be on a 256 byte boundary (i.e. the two least significant digits must be 0).

The extended address must be a hexadecimal value in the range 0x00000000 to 0xfff80000 and must be on a 512kbyte boundary (i.e. the five least significant digits should be either 0x00000 or 0x80000).

For example, to set the short address to 0xbe00 and the extended address to 0x1c800000, enter the following commands:

```
s 0xbe00
e 0x1c800000
```

More advanced settings may also be changed through this menu. They include the VME bus request level and release mode which set up the hardware to act in certain ways when performing VME master accesses, and the default interrupt level and vector which may be used by application programs which use VME interrupts.

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2.1.2 Changing the Video Format

From the Main Menu, selecting the 'V' option takes you into the Video Setup Menu. From this menu and the sub-menu, you may view and edit the EERAM entries that specify the way the video card is initialised. This may only be performed if a video card is physically present on the CAT card since the menu is tailored to the type of card present.

When the Video Setup Menu is entered, the current EERAM settings are displayed. This can also be done using the 'p' (print) option from this menu.

There are two ways of setting up the video format. The simplest way is to select from a list of pre-defined formats which will set all the entries at once. For more complex situations, the individual entries may be edited through a sub-menu (entered with the 'E' option).

The list of predefined formats may be examined with the 'l' (list) option which prints a brief description of each format together with the identifying number for that format.

Any particular format may be viewed in more detail with the 'v' option. By default this will print details of format 0, but any of the other formats may be viewed simply by specifying the required number as an argument.

A complete format may be programmed into the EERAM with the 'f' option (which prints the format in detail and asks for confirmation before actually changing the EERAM). Again, this defaults to format 0 but any other format may be programmed instead by specifying the required number as an argument.

To edit individual values in the currently programmed video format, enter the Video Setup Edit Menu by selecting the 'E' option from the Video Setup Menu. This allows you to tailor the predefined formats to your specific needs, or even to program a completely different format entirely.

For example, the pixel clock frequency may be changed in one of two ways, although note that certain video cards (notably the Tiger) have fixed pixel clocks and therefore the following should be ignored.

The simplest method of setting the pixel clock is to use the 'a' option to auto-calculate the dividers. This will calculate (if possible) and re-program the dividers for the specified frequency. For example, to set a 108 MHz pixel clock, use the following command:

```
a 108
```

Alternatively, the feedback, reference and output dividers may be specified directly using the 'd' option. For example, to set a 108MHz pixel clock on the Lion, use the following command:

```
d 5,54,2
```


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The valid values for the dividers depend upon the specific video card and reference clock frequency fitted on the CAT. For more information, please refer to the Technical Manual for your video card. It is possible to enter invalid formats using this menu which will cause errors to be given when the CAT is next reset.

Other settings available through the Video Setup Edit Menu include changing the page width, enabling and disabling interlacing, sync-on-green, pedestal and the horizontal and vertical timing characteristics of the video signal. For more information please refer to the Technical Manual for your video card, and to the Texas Instruments TMS320C80 (MVP) Video Controller User's Guide.

2.1.3 Changing the Monitor Options

From the Main Menu, selecting option 'M' takes you into the Monitor Options Menu under which various settings which determine the way the Monitor itself works may be changed.

The '`p`' option will print the current Monitor Options. This is automatically performed when this menu is entered.

The '`P`' option enters the Primalib Options menu under which various settings may be set up to control the run-time operation of the Primalib graphics library. For more information, please refer to the Primalib Technical Manual.

Each of the other commands available under this menu will toggle the corresponding Monitor Option between the two possible states, as described in the following sections.

2.1.3.1 RAM Test Override

The '`m`' option alternately enables and disables the memory tests that are normally run with the other diagnostic tests during CAT boot-up sequence.

These tests are destructive (i.e. they will not preserve the original contents of memory) which is obviously not too important at power-up (since the contents of the memory are undefined anyway) but at reset it is sometimes desirable to preserve as much of the memory contents as possible. Some of the memory is unavoidably changed since the Monitor needs to use some for it's own data, but this option allows the majority to be preserved.

Note that when memory tests are disabled, they are treated as though they failed and will be reported as such as part of the boot process to draw attention to the fact that they have not been executed. Under normal circumstances, they should be enabled.

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2.1.3.2 Console Port A/B

The ‘c’ option controls which serial channel the Monitor uses for the console interface (i.e. these menus). By default this will be channel A but this option may be used to force the Monitor to use channel B instead.

If it is set to A, then all boot messages and menu actions are performed through serial port A.

If it is set to B, then the boot messages are all output via port A (since most tests are performed before the status of this option is known), but once the CAT has been fully initialised, the Monitor switches to port B for interaction with the user. At this point, if any errors occurred during the built-in-test, an extra warning is printed to ensure the user is aware of them.

Before switching to port B, the Monitor prints a warning on port A and gives the user the chance to press Escape (again on port A) in which case it stays with port A rather than switches. This allows an easy way of recovering when your terminal is connected to port A but the CAT is set to use port B.

Unless there are specific reasons for using port B, it is strongly recommended that port A is always used. This means that the full boot-up messages are always visible on the terminal, and the boot-process itself is quicker.

2.1.3.3 Autoboot Enable

The ‘b’ option can be used to control whether or not the Monitor should automatically boot the embedded application program from Flash memory. This is described in more detail in section 2.2. See also section 2.1.3.4.

2.1.3.4 Autoboot Delay

If the card is set to automatically boot the embedded application program from Flash memory (see sections 2.1.3.3 and 2.2), there will normally be a short (approximately two seconds) delay during which the autoboot may be aborted by pressing Escape on the terminal connected to the serial line.

The ‘d’ option may be used to disable this delay to speed up the boot sequence. Note that even if the delay is disabled, the autoboot may still be prevented by pressing Escape before it commences.

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2.1.3.5 Autoboot Option Override Enable

In complex systems, it is sometimes necessary for a host based application to override the option described above which controls whether or not the embedded application will be booted from Flash and so as described in section 2.2, certain magic values may be written into the shared memory to control the booting process.

To avoid the situation where values 'accidentally' left in memory cause undesired effects on the boot sequence, this override capability must be explicitly enabled using the '`o`' option in the menu.

2.1.3.6 Startup Image

Under normal circumstances, the Monitor will draw a 'startup' screen once the CAT card has been initialised (assuming a display card is fitted). This provides visual feedback that the card has booted and is working, as well as ensuring that the video framestores are initialised to a known state rather than containing whatever image may be left from a previous application.

However, it is sometimes desirable to prevent this startup image being drawn (for example, to reduce the time taken for the boot sequence) and so the '`i`' option is provided to enable and disable the drawing of the image.

2.1.3.7 Video Setup

One of the actions that the Monitor usually performs during the boot sequence is to initialise the C80 Video Controller for the display format stored in the EERAM. Occasionally this is not required and the '`v`' option is provided to allow this action to be disabled.

2.1.4 Viewing the Results of the Built-in-Self-Test

At power-up/reset, the Monitor tests the various components and connections on the CAT and display card. As well as printing status messages out to the terminal, the results are also stored at the top of the block of Shared SRAM.

These results may be viewed using the 'b' (for Built-In-Self-Test) option from the Main Menu. Each test is listed together with the result of that test. The results may be either 'passed' (normal conditions), 'not executed' (something prevented the test from being run) or 'failed'. Tests that have failed will have a number associated with them. This will normally indicate how 'bad' the failure was. For example, memory tests that fail will state the number of errors that were detected.

Also, these results may be viewed using the host-based downloader, **catload**. This is described in more detail in section 3 of this User Guide.

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2.2 Embedded Application Programs

The Monitor itself only occupies the top quarter of the Flash memory (i.e. the top 256kbytes of the 1Mbyte total). The remainder of the Flash memory may be used to store a user application program. This embedded program may be automatically booted by the Monitor at power-up/reset of the CAT, or on-demand by selecting an option in the Main Menu from a terminal connected to the serial line (see section 2.1).

The embedded program may be blown into the Flash memory using the Flash programmer (**catblow**) described in section 4. Conversely, your CAT may have been shipped with an application program already present in the Flash. In either situation, the options for booting/not booting the program are the same.

The booting of any embedded program is just like downloading a program from a host in that it completely replaces the Monitor - i.e. the monitor does not continue to run in the background. To get back to the monitor, you would have to reset the CAT (either using the front panel button or writing to the reset register - see the CAT Technical Manual for more information).

The Monitor Main Menu (see section 2.1) enables the user to check whether or not there is a COFF file present in the Flash memory on the CAT. Simply selecting the 'c' option will check if there is a COFF file present or not. Adding a number in the range 0-3 after the 'c' will give more information (the higher the number the more information printed). For example, the command

```
c 0
```

will print the version, type, date, number of sections, start address and so on of the COFF file present in the Flash.

COFF files may contain an identifying string which the Monitor will search for and print at certain times (such as the 'c' option above, and when it is about to auto-boot). This string is also printed by the **coffinfo** utility described in section 5. Most Primagraphics COFF files will contain such a string.

This string should (if desired) be added to a COFF file as an extra section called ".ident" which consists of the required string followed by a 0. The simplest way to do this is probably to add lines such as the following to the end of one of your C source files:

```
asm(" .sect \".ident\" ");
asm(" .byte \"This is my identifying string.\" ");
asm(" .byte 0");
```

The contents of the string should be changed to reflect the content of the program, perhaps containing a version number or date as required. You will also need to add the .ident section to your linker command file.

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2.2.1 Automatic Booting

The Monitor will only boot the embedded application program if several conditions are satisfied. Firstly, there must actually be a recognised program in the Flash memory. This must be a standard C8x COFF file containing a big-endian executable program. The conditions on the memory usage of the program are the same as for any program which is downloaded from the host, and are described at the start of this chapter.

Secondly, the EERAM must be set up such that the Monitor Options specify that the embedded program should be booted automatically. See section 2.1.3.3 for more details of this option.

Thirdly, the hardware links to override the above conditions and force the Monitor not to boot the embedded application must not be inserted. For details of these links, refer to Appendix B or the CAT Technical Manual.

Finally, the host must not have overridden this option by writing certain magic values into the shared memory (see section 2.2.3 for more details).

If all of these conditions are satisfied, then at power-up/reset, the Monitor will print a brief message over the serial line giving the user the chance to prevent the auto-boot (by pressing Escape on the terminal) and then the program will be loaded from Flash into normal memory and executed.

2.2.2 On-Demand Booting

If the Monitor did not auto-boot the embedded user program, then it is possible to force it to boot the program at a later stage. This may be performed through one of the Main Menu options (see section 2.1 for details of how to use the menus).

From the main menu, simply select the 'e' option to boot the embedded user application program. This will ask for confirmation, and if 'y' (or 'Y') is entered then the embedded program is booted (assuming there is a valid COFF file in the Flash memory).

2.2.3 Host Override

If enabled (using the Monitor Options ‘o’ option as described in section 2.1.3.5), host applications may override the ‘normal’ rules controlling whether or not the embedded user program is automatically booted on startup by writing predefined 32-bit values into certain locations in shared memory.

The two locations of interest are at byte offsets of 0x0007fe00 and 0x0007fe04 from the base of the shared memory (e.g. VME A32 addresses of 0x1c87fe00 and 0x1c87fe04 for CAT cards at the default VME address).

For the override to occur, the first location (i.e. the 32-bit word at offset 0x7fe00) must contain the value 0x4f564552 (which is given by the `MONITOR_STARTUP_OVERRIDE` definition in the **moncommon.h** header file). Note that this is constructed from the ASCII codes for the string “OVER”.

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The value at the second location then controls precisely what the Monitor should do. If a recognised value is found, then the corresponding action is performed, otherwise the Monitor acts according to the rules described in section 2.2.1.

The permitted values for the second location are 0x426f6f74 (“Boot”) to force the Monitor to boot the embedded application and 0x4e6f6e65 (“None”) to prevent the autoboot. (These are given by the `MONITOR_STARTUP_BOOT_ONLY` and `MONITOR_STARTUP_NONE` definitions respectively).

The values 0x54657374 and 0x426f7468 currently have the same meanings as “None” and “Boot” respectively but are reserved for future use and should thus be avoided by existing applications.

2.3 Overriding EERAM Contents

As mentioned earlier, the EERAM contains checksums for various groups of the configuration information and if these checksums are incorrect then the contents of the EERAM are assumed to be corrupt and default values are used instead.

However, sometimes it is desirable to temporarily use default values without re-programming the EERAM. This may be achieved by inserting one or more of the hardware links on the CAT.

Fitting link D3 will force the Monitor to ignore the contents of the EERAM and instead use the default settings when initialising the VME interface and video format. Removing the link will revert back to using the contents of the EERAM.

Fitting link D4 will disable the automatic booting of the embedded user application program in the Flash memory unless overruled by a host application (see section 2.2.3). Removing it will allow it to be booted automatically if all the other conditions are met (see 2.2.1).

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3. Downloader

The CAT host support utilities include a COFF downloader, **catload**. This allows COFF files to be downloaded and run on CAT cards in VME systems which have a host computer with access to the VME bus.

This utility is supplied pre-compiled for standard Sparc embedded VME cards (such as the Force 5V). The source code is also provided so that it may be recompiled for different hosts (see section 6).

At its most basic, **catload** simply takes the name of a COFF file as a command line argument, resets the CAT card, reads the file in and writes it a block at a time over VME to the shared SRAM on the CAT processor card. The CAT Monitor that executes at reset from the Flash memory on the CAT reads the data from the shared memory and copies it to the required location in the C80 memory map. Once the whole file has been downloaded, the Monitor jumps to the entry point and executes the program.

COFF files to be downloaded in this way should not make use of the reserved memory areas for initialised data (although they may use them after they start executing). See Appendix C for details of the reserved memory.

This also allows the user to retrieve and display the results of the Built In Self Test which is performed with functions from the file **monbist.c**. Since the utility is supplied as source code, this provides an example of how such functionality may be incorporated into other host application programs.

Note that for **catload** to be able to download COFF files to a CAT, the CAT must be executing the Monitor. It must not have booted any embedded user application program from Flash memory. Details of how to ensure this are given in section 2.2.1. If the card is set to autoboot the user program, the utility will automatically attempt to prevent this by temporarily changing the appropriate options in EERAM. However, this relies on the write-enable link being fitted and so may fail. Also, since EERAM devices support a limited (albeit high) number of write cycles, this should be avoided whenever possible to prolong the life of the EERAM device.

Through the command line options described in the next section, **catload** provides a variety of different operational modes.

3.1 Command Line Options

Running **catload** without any command line arguments will print a list of the options available, which are as follows:

-v	Print verbose information.
-k	Do not reset the CAT card before downloading the COFF file. (This is usually only used for debug purposes, or for retrieval of BIST results without downloading a COFF file - see the '-b' option.)
-e	Do not access EERAM to prevent autoboot. (This is only used when the card is autobooting an application which emulates the boot server of the Monitor.)

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-b	Retrieve Built-In-Self-Test results. Using this option with a COFF file name will firstly retrieve the BIST results and, if all tests passed, then download the program. Using it without a COFF file name will simply retrieve the results. More detail is printed if the -v option is also used.
-n	Load program but do not start the C80. (This is usually only used for debug purposes.)
-t secs	Set the time delay (in seconds) between resetting the CAT and commencing the download of the COFF file. By default, this is set to three seconds but may be altered for particular systems.
-r addr	Use the given (hexadecimal) address for the CAT registers in short address space (instead of the default one of 0xbe00).
-a addr	Use the given (hexadecimal) address for the CAT shared memory in extended address space (instead of the default one of 0x1c800000).

The name of the COFF file (if required) should always be the last command line argument.

Options without additional arguments (i.e. v, k, b and n) may be grouped together on the command line.

Examples of the use of this utility are given in section 3.3.

3.2 CAT_DIR Environment Variable

The COFF file to be downloaded by the host utility is assumed to be in the current directory (or the path specified relevant to the current directory). However, it is possible to force the utility to search a number of other directories by setting the `CAT_DIR` environment variable.

The `CAT_DIR` environment variable should contain a list of colon or semi-colon separated directories to search for the COFF file. The host utility will first look in the current directory and then search through `CAT_DIR` (if set) until it finds a file with the given name.

Note that if a relative path name is specified for the COFF filename and the `CAT_DIR` environment variable is set, then the directories listed in `CAT_DIR` are searched with the relative path name. For example, specifying the COFF filename "../my_coff.out" will first look in the parent directory of the current directory, and then in the parent directory of all the directories listed in the `CAT_DIR` environment variable.

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3.3 Examples

The command:

```
catload my_coff.out
```

will download the COFF file "my_coff.out" to a CAT processor card at the default VME addresses (0x1c800000 extended address and 0xbe00 short address).

The command:

```
catload -v -r0xbd00 -a0x1c900000 ../my_coff.out
```

will download the COFF file "my_coff.out" from the parent directory to a CAT processor card at 0xbd00 (short) and 0x1c900000 (extended), printing verbose information as it goes.

The command:

```
catload -bvk
```

will retrieve the BIST results from a CAT at the standard address, without resetting the card, and print details of the status of each test.

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4. Flash Programmer

The CAT host support utilities include a Flash programmer, **catblow** (which also uses a C80 program **c8xflash.out**). This is primarily provided to allow COFF files to be programmed into the lower three quarters of a megabyte of Flash memory on the CAT card, although as described below it may also be used for more advanced actions.

This utility is supplied pre-compiled for standard Sparc embedded VME cards (such as the Force 5V). The source code for the host program is also provided so that it may be recompiled for different hosts (see section 6).

As with the COFF file downloader **catload** described in the previous chapter, the most basic use of this utility simply consists of reading in a file to be programmed into the Flash memory on the CAT card and writing that in blocks over VME to the shared SRAM on the CAT processor card. A special C80 program is also downloaded which reads the data from the shared SRAM and programs it into the Flash memory.

Note that for **catblow** to be able to download COFF files to a CAT, the CAT must be executing the Monitor. It must not have booted any embedded user application program from Flash memory. Details of how to ensure this are given in section 2.2.1.

Also, it must be able to download the C80 program **c8xflash.out**. This means that the program must either be in the directory from which you are running the utility, or in one of the directories listed in the search path given by the `CAT_DIR` environment variable (see section 3.2).

The main use of this utility is to program a COFF file into the Flash memory. This COFF file may then be automatically booted by the Monitor when the card is powered-up or reset. For more information on this, please refer to section 2.2 of this user guide.

Be aware at all times that only one file may be programmed into the user section of the Flash memory - i.e. programming a new COFF or data file into the Flash memory may overwrite a valuable program already present there.

No special action is required when building a COFF file to be programmed into the Flash memory as opposed to COFF files to be downloaded directly. However, as with COFF files downloaded directly, your programs should not make use of the reserved memory areas for initialised data (although they may use them after they start executing). See Appendix C for details of the reserved memory. You may find it useful to include an identification string in your COFF file as described in section 2.2. Also, it may be necessary to reduce the size of the COFF file by stripping the symbol table information from it at the linking stage - this may be done by passing the -s option to the Texas Instruments linker.

However, instead of programming a COFF file, this utility may be used to program raw data into the Flash memory, such as map coordinates required by an application program. In fact, any single file up to 768kbytes may be programmed, although obviously only valid COFF files may be booted by the Monitor. The procedure for programming data files is exactly the same as that for programming COFF files.

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The third use of the **catblow** utility is to reprogram the CAT firmware itself (i.e. the Monitor) although this MUST NOT be performed unless you are absolutely certain of what you are doing. The Monitor resides in the top 256kbytes of Flash memory, and if it is deleted or corrupted, your CAT card will be useless until the Flash memory is reprogrammed by an external PROM programmer. Thus, do NOT use the '-monitor' option unless under express instructions from Primagraphics.

The command line options described below control the operation of the Flash programmer. Examples of the use of this utility are also given below.

4.1 Command Line Options

Running **catblow** without any command line arguments will print a list of the options available, which are as follows:

-v	Verbose - print more information regarding what actions are being performed.
-k	Do not reset the CAT card before downloading the COFF file. (This is usually only used for debug purposes.)
-n	Do not actually program the Flash memory. (This is usually only used to check that your other arguments are valid.)
-r addr	Use the given (hexadecimal) address for the CAT registers in short address space (instead of the default one of 0xbe00).
-a addr	Use the given (hexadecimal) address for the CAT shared memory in extended address space (instead of the default one of 0x1c800000).
-x	Do not reset the card after programming.
-erase	Erase the embedded user program. This blanks the first 768kbytes of Flash memory, preserving the Monitor in the top 256kbytes.
-monitor	Re-program the CAT firmware. DO NOT use this option unless under the explicit instructions of Primagraphics personnel.

The name of the file to be programmed should always be the last command line argument. No filename is required when erasing the contents of the Flash memory.

Options without additional arguments (i.e. v, k, n and x) may be grouped together on the command line.

Examples of the use of this utility are given in section 4.2.

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4.2 Examples

To program the file 'my_file.out' (which may or may not be a COFF file) into the Flash memory of a CAT at the default address, printing verbose information, execute the following command (remembering that **c8xflash.out** must also be in the current directory or the `CAT_DIR` environment variable must include its directory):

```
catblow -v my_file.out
```

To erase the embedded user application program or data on a CAT at the VME addresses 0xbd00 (short space) and 0x1c900000 (extended space), use the following command:

```
catblow -r0xbd00 -a0x1c900000 -erase
```

WARNING: Ensure that you are not overwriting valuable data already in the Flash memory of your CAT card. Do NOT use the '-monitor' option unless instructed to do so by Primagraphics.

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5. Other Utilities

As well as the main host utilities **catload** and **catblow** (described in previous sections), various minor utilities are also supplied, including those described below.

5.1 COFF Information Extractor

The **coffinfo** utility extracts information from COFF files and prints out a selection of it such as the date it was linked, the number of sections in it and so on.

It may be run with a command such as:

```
coffinfo -vvv my_coff.out
```

For less information, simply use less '-v' options.

COFF files may be given an identifying string if you wish and this will be printed by the **coffinfo** program when executed. This string will also be printed by the CAT monitor when checking what COFF file is present in the Flash memory. For more information on this, please refer to section 2.2 of this user guide.

5.2 Reset Utility

The **catreset** utility allows one or more CAT cards to be reset via VME from the host. Run without any arguments, it will simply reset a CAT card at the default VME address. By listing one or more short (A16) VME addresses, other cards may also be reset.

For example, the command:

```
catreset
```

will simply reset a card at the default address.

Alternatively, the command:

```
catreset 0xbd00 0xbe00
```

will reset CAT cards at the short addresses of 0xbd00 and 0xbe00.

If desired, the two trailing zeroes may be omitted from the addresses. Hence, the second example above could have been written as:

```
catreset 0xbd 0xbe
```


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5.3 Memory Reader

The **catread** utility may be used to read data back from CAT cards once an application has finished executing.

It first resets the card and then uses a similar mechanism to that used for downloading to copy the data from the card (via the shared memory) to a file on the host. The options are generally the same as those for catload (allowing VME addresses to be specified and so on) but this utility also requires the C80 address from which data should be read, the number of bytes that should be read starting from that location and the name of the file into which the data should be written, as follows:

```
catread [options] <C80 address> <numbytes> [filename]
```

If no filename is specified, then the data read is streamed to stdout.

For example, to read 1024 bytes of data starting at C80 address 0x02000000 (which on the CAT is the start of the SDRAM), printing verbose information about what is happening, use the following command:

```
catread -v 0x02000000 1024 sdram.data
```

This will read the data into a file called **sdram.data**.

5.4 EERAM Editor

The **cateeram** utility provides a primitive method of editing the EERAM on the CAT from the host. This may be useful in situations where the menu interface provided by the Monitor cannot be accessed via a terminal connected to the serial line for whatever reason.

It is strongly advised that whenever possible the EERAM is changed via the menu interface, not via the host based editor. This is because the Monitor provides more checking that the settings being entered into the EERAM are valid and consistent for the particular hardware present.

When run with no command line options, **cateeram** simply reads the contents of the EERAM from a CAT at the default VME short address (i.e. 0xbe00) and outputs them in human readable form to `stdout`. The address used may be changed in the same way as for the **catload** utility.

If a filename is specified (as the last argument on the command line), then the contents of the EERAM are written (again in a human readable form) to that file rather than `stdout`.

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To change any of the EERAM settings, the file containing the current EERAM contents should be edited with your preferred text file editor. It is important that the format of the file is preserved and that only the particular values you wish to change are altered. For example, to change the VME base addresses from the default values (0xbe00 and 0x1c800000) to 0xbd00 and 0x1c900000, edit the following two lines within the file:

```
A16         0xbe00          # A16 address
A32         0x1c800000      # A32 address
```

so that they now read:

```
A16         0xbd00          # A16 address
A32         0x1c900000      # A32 address
```

Having edited the file to contain the desired EERAM settings, use the **cateeram** utility with the `-write` command line option, specifying the name of that file. Note that once this has been done and the card is reset, it will be mapped at the new VME addresses and thus the `-r` and `-a` options must be used as required to specify the new address to CAT host utilities.

For example, to read the contents of the EERAM of a CAT at the default VME address into a file name **eeram.cfg**, use the following command:

```
cateeram eeram.cfg
```

Having edited the file to contain the new settings required for the EERAM, the following command will write the new contents back to the EERAM:

```
cateeram -write eeram.cfg
```

If the VME short base address has been changed to 0xbd00 (as described above), then the new EERAM contents may be read back and output to stdout with:

```
cateeram -r 0xbd00
```

Note that the EERAM write enable links must be fitted for the EERAM to be edited (see Appendix B).

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6. Source Code

This software package contains both host and target (C80) programs.

The target programs are COFF files to be downloaded to the CAT processor card, and as such are independent of the host platform. Thus, these are shipped as COFF files only, without the source code (e.g. **c8xflash.out**).

The host programs (**catload**, **catblow** etc.) are dependent upon the platform on which they will execute. They are supplied precompiled for Solaris 2 on a SPARC, but come with full source code to enable them to be recompiled for different host platforms. This can be found in the "CAT/Source" subdirectory.

The files "mem_map.c" and "mem_map.h" provide the basic functions required to access VME boards from the host. If these do not already provide support for your host platform, then they will need to be extended to do so. Please refer to the notes in those files for more information.

The other files in the source directory provide the source for the utilities themselves. There is a Makefile which may be used to recompile the files as required, and a README which gives more information on the way the utilities are created.

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APPENDIX A – Menu Hierarchy

The menus provided by the Monitor to users connecting a Terminal to the front panel serial port (see section 2.1) are as follows. Note that all menus also provide the generic options:

.	Repeat the previous action,
?	Print the available options,
q	Quit this menu and return to the parent menu (not available from the Main Menu).

A.1 Main Menu

This menu provides some of the most common options, and the entry into the various sub-menus.

b	Retrieve BIST results. This prints the results of the Built In Self Test
c [0..3]	Check embedded user program. This prints information about the COFF file (if any) present in the user section of the Flash memory
D	Debug Menu
e	Boot embedded user program
h	Show hardware. This lists the types and versions of the CAT and video display cards present
I	VME Interface Menu
M	Monitor options Menu
s	Soak test. This executes the built-in soak test and is intended for use by Primagraphics engineers only
T	Test Menu
V	Video Setup Menu
d	Toggle Debug information. This may be used to enable debugging information when downloading and booting COFF files

A.2 Debug Menu

This menu is provided for Debugging purposes only. It allows C80 memory addresses to be peek'ed and poke'd directly. It is only intended for advanced users.

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A.3 VME Interface Menu

This menu allows the VME configuration settings to be edited in EERAM. Most of the options are self-explanatory but are described in more detail in section 2.1.1.

s <addr>	set Short address base
e <addr>	set Extended address base
i 0-7	set Interrupter level (0=none)
v <vector>	set interrupter Vector
h <bitmask>	set interrupt Handler levels
b 0-3	set Bus request level
r r/d/c	set bus Release mode
f <usecs>	set Fairness (0=off, (>30)=no timeout)
a p/r	set slot 1 Arbitration priority/round robin
t <usecs>	set slot 1 transfer Timeout
w 0/1	set slave post Write disable/enable
1 <type>	set daughter board 1 type
2 <type>	set daughter board 2 type
p	Print current settings
d ALL	set Default values for all above settings

The daughter board types should only ever be changed if application daughter boards are physically added or removed from the CAT.

A.4 Monitor Options Menu

This menu allows changes to the way in which the Monitor itself operates. The following options are provided (see section 2.1.3 for more details).

m	Toggle the RAM tests. This may be used to disable the memory tests at power-up/reset
c	Toggle the serial port used for Terminal interaction (between A and B)
b	Toggle the autoboot from Flash (between enabled and disabled)
d	Toggle the autoboot delay (between on and off)
o	Toggle the autoboot options override in SHSRAM (enabled/disabled)
i	Toggle the drawing of the startup image at reset (enabled/disabled)
v	Toggle the video frame timer setup (enabled/disabled)
p	Print the current options

The memory tests should normally be enabled and port A should normally be used for the serial port.

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A.5 Test Menu

This menu provides advanced built-in test facilities intended only for use by Primagraphics engineers.

However, there is one option which may be required by certain CAT users. The 's' option may be used to re-program the whole of the EERAM with the default configuration parameters - i.e. to return the EERAM to the state in which it would normally have been supplied.

A.6 Video Setup Menu

This menu provides access to the predefined video formats.

v [<format>]	View predefined format (default 0)
f [<format>]	Program predefined format (default 0)
l	List the predefined formats
E	Enter format editing menu
p	Print current settings

The formats depend upon the exact type of video card fitted and so are not listed here. The 'E' option takes you into the Video Setup Edit Menu described below.

A.7 Video Setup Edit Menu

This menu allows the user to edit the individual settings of the video display format. It is intended for advanced users only.

w <width>	Set page width
s <width,height>	Set screen width and height
h <blank,sync,porch>	Set horizontal timing characteristics
v <blank,sync,porch>	Set vertical timing characteristics
d <ref,feedback,output>	Set pixel clock dividers
a <freq>	Auto-calculate and set pixel clock dividers
x	Toggle External Pixel Clock Enable
i	Toggle Interlaced Operation
l	Toggle Pedestal Enable
g	Toggle Sync-on-Green
c	Toggle Composite Sync
t h/v	Toggle Horiz/Vert Sync direction
p	Print current settings
f	Print current settings in C80 format

The allowable values depend upon the particular type and version of video card fitted to your CAT. For more information, please refer to the relevant Technical Manual.

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APPENDIX B – Hardware Link Settings

The hardware links have the following meanings. For more information, please refer to the CAT Technical Manual.

Link D0 may be fitted to enable the CAT as VME Slot 1 System Controller.

Link D1 may be fitted to enable writes to EERAM area 'A'.

Link D2 may be fitted to enable writes to EERAM area 'B'.

Link D3 may be fitted to force the Monitor to ignore the contents of EERAM and use default values for configuring the CAT card. This also prevents the Autoboot.

Link D4 may be fitted to prevent the Monitor booting the embedded user application program from Flash memory (i.e. to override the Monitor Options).

Link D5 may be fitted to cause the Monitor to operate in Silent Serial I/O mode where nothing is output on the serial channel and all input is ignored.

Links D6 - D7 are available for user-defined purposes.

NB: Link D0 is furthest from the P1 connector.

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APPENDIX C – Memory Usage

The monitor reserves the following areas of memory which must not be used for initialised data by COFF files that are to be downloaded or booted from Flash memory.

SDRAM	The top 512 kb of SDRAM. On 8 Mb cards this will be the address range 0x02780000 to 0x027fffff. On 32 Mb cards this will be the address range 0x03f80000 to 0x03ffffff.
SHSRAM	The bottom 32k + 16 bytes of Shared SRAM, i.e. addresses 0x0a000000 to 0x0a008010.
SHSRAM	The top 512 bytes of Shared SRAM, i.e. addresses 0x0a07fe00 to 0x0a07ffff since the background BIT and BIST results are stored here.

These memory areas may be used freely once your program has begun execution (e.g. for your stack or heap) with the exception of the background BIT area.

In addition, the Console Emulator utility that is occasionally blown into the Flash memory to autoboot on reset and act as a simple console to a Sparc host and emulate the boot server capabilities of the Monitor also reserves the following memory:

SDRAM	The penultimate 512 kb of SDRAM. On 8 Mb cards this will be the address range 0x02700000 to 0x0277ffff. On 32 Mb cards this will be the address range 0x03f00000 to 0x03f7ffff.

For C80 programs to be downloadable to both the Monitor and the Console Emulator, all of the above memory areas should be avoided by initialised code and data.

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APPENDIX D – Terminal Output at Reset

When connecting a terminal to the CAT serial port, messages such as the following should be seen at reset (under normal conditions).

```
QUART tested and initialised.
EERAM checksums okay.
Testing SDRAM ... passed.
Testing Shared SRAM ... passed.
Testing and initialising VME interface ...
Testing VME FPGA Registers ... passed.
Testing VIC Registers ... passed.
VME interface initialised.
Checking video display card ... done.
Video display card is Lion, (0x0705, V0, FPGA 0).
Testing Lion video card ...
Lion video card test passed.
Initialising Lion video card ...done.
Initialising CLUTs ... done.
Checking Leopard board on site 1 ... found (V0, rev 1).

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                Main Menu

b         Retrieve BIST results
c [level] Check embedded user program (verbose level 0-3)
D         Debug Menu
e         Boot embedded user program
h         Show hardware
I         VME Interface Menu
M         Monitor options Menu
s         Soak test
T         Test Menu
V         Video Setup Menu
d         Toggle Debug information
.         repeat
?         re-print menu

main>
```

This assumes that a Lion video card (version 0, FPGA revision 0) and a Leopard application daughter board are fitted to the CAT and that there is no user application program in Flash memory. The messages will differ if other boards are fitted or the Flash memory contains a program.

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