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Matrox Genesis

Installation and Hardware Reference

Manual no. 10503-MN-0122

January 19, 1999

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Chapter 1: Introduction

This chapter briefly describes the features of the Matrox Genesis family of imaging boards, as well as the software that can be used with the boards.

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The Matrox Genesis boards

The Matrox Genesis family is a series of single-slot, PCI imaging boards that feature on-board, high-speed processing. The Matrox Genesis boards come with custom software with which to develop your applications. Scalability is available by interconnecting additional boards.

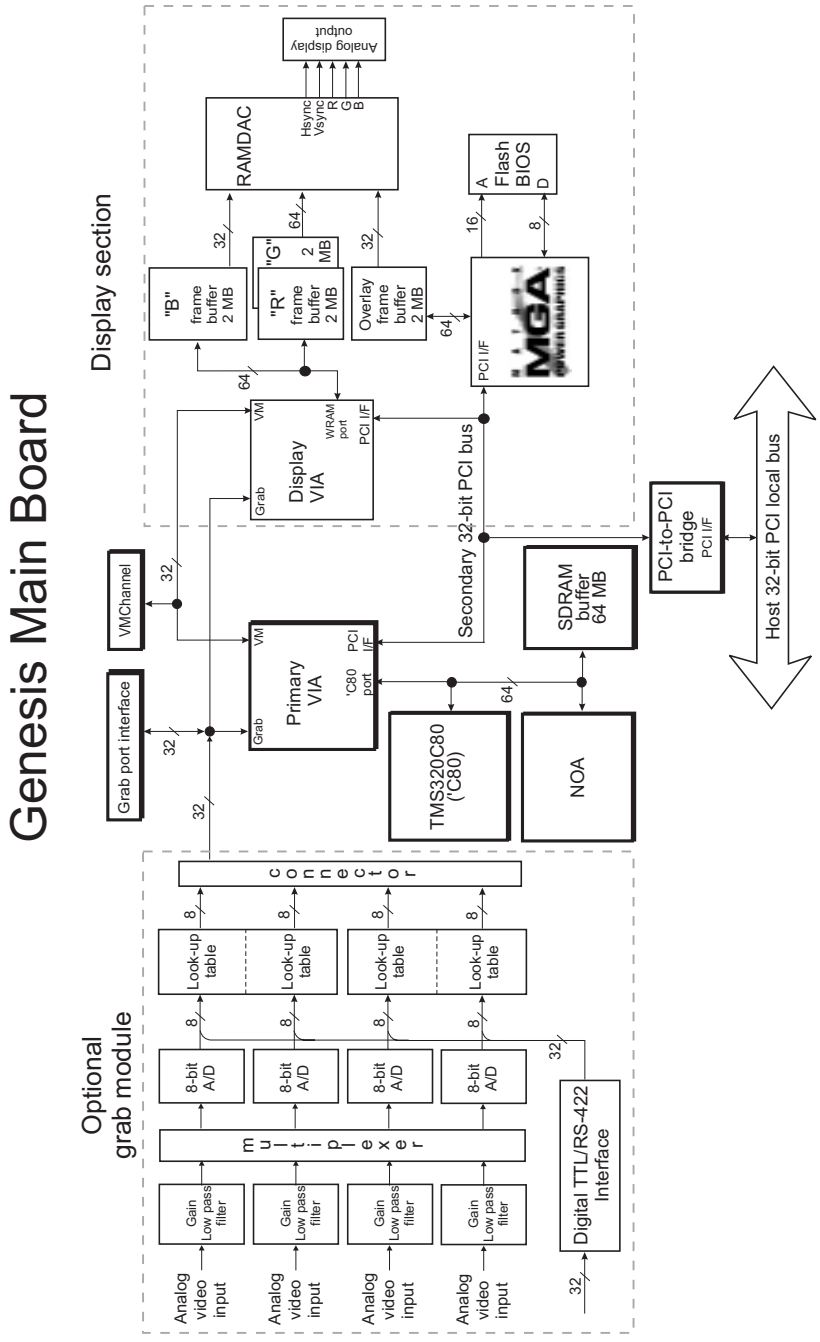
The Matrox Genesis family consists of two types of configurable boards: the Genesis main board and the Genesis processor board. This manual generally refers to the Genesis boards simply as Genesis. When it is necessary to distinguish between them, the manual refers to the main board or to the processor board.

The Matrox Genesis main board is an imaging board with a processing section, as well as an optional grab module and/or an optional display section.

As its name implies, the Matrox Genesis processor board is a board that is dedicated to processing. It is available in either a single or a double processing configuration. It does not include a grab module or a display section.

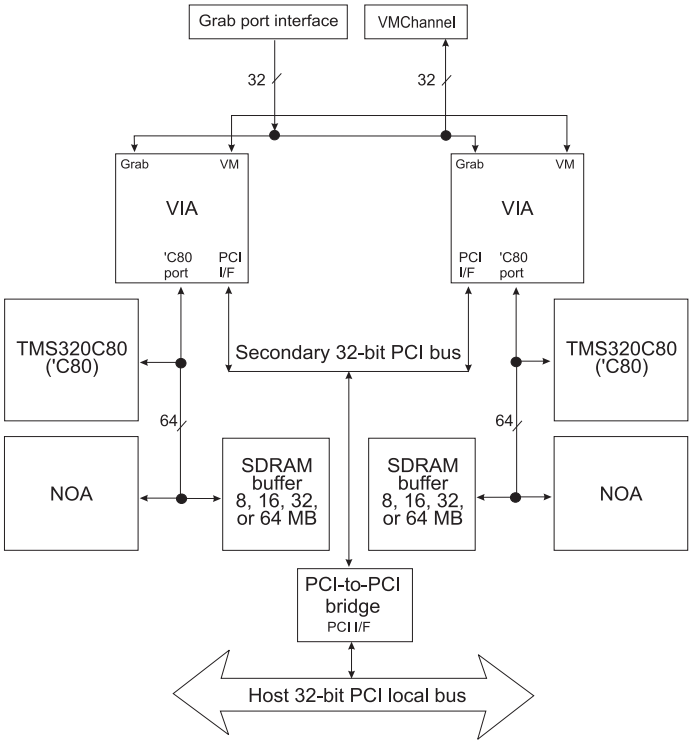
In addition to the main board and the processor board, the Matrox Genesis family includes a low-cost version of the main board (Genesis-LC). Genesis-LC is basically the main board without a processing section. In general, this manual does not explicitly refer to the Genesis-LC because any discussion of the main board also applies to the Genesis-LC (including steps for installation and description of connectors but excluding any discussion of the processing section).

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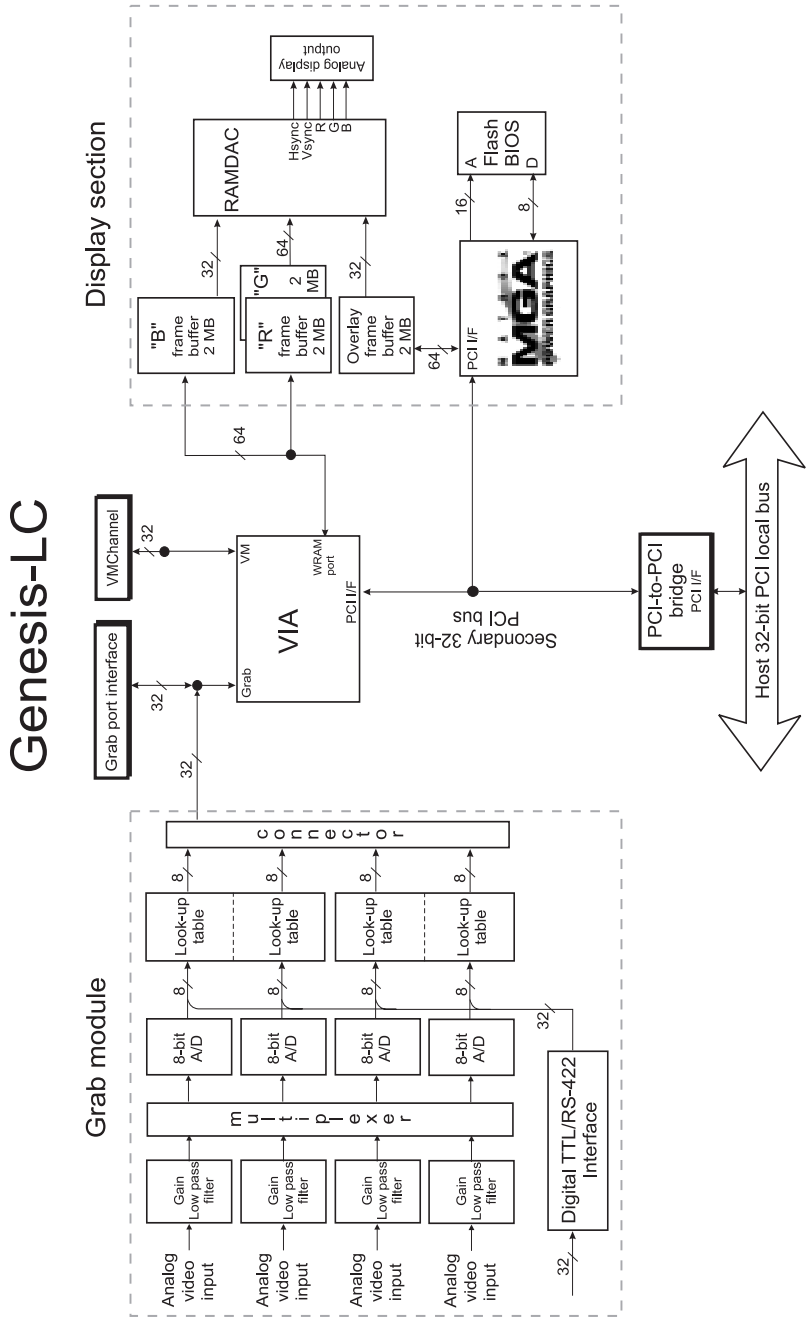


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Genesis Processor Board



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Features of the Genesis hardware

TMS320C80

The TMS320C80 ('C80) is a single-chip, digital signal multi-processor that features a 32-bit RISC master processor (MP) with a floating-point unit. The MP coordinates on-chip processing activities and controls communications within the 'C80. The 'C80 has four parallel processors (PPs) for high-speed processing. These PPs are 32-bit advanced, fixed-point DSPs with 64-bit instruction words. The 'C80's transfer controller (TC) manages memory traffic at up to 400 MBytes/sec (the peak transfer rate when the 'C80 is operating at 50 MHz) for data transfer between on-chip and off-chip memory.

VIA

The VIA (Video Interface ASIC) is an intelligent controller (router) that provides high-performance links between the acquisition, display, and processing sections in the Matrox Genesis system, as well as to/from external resources. It is also a powerful data formatting engine, and is responsible for device synchronization. The Genesis main board has two VIAs: the primary VIA (in the processing section) and the display VIA. The processor board also has two VIAs.

The VIA provides a powerful video interface for the grab port, the VMChannel, the 'C80 connection, the SDRAM, and a PCI master/slave bus interface. It supports tag (pixel masking) buffers for grab and VMChannel transfer. The VIA can be configured to recognize continuous or single-frame/field (snapshot) grabbing and programmed for progressive, interlaced, or line grab modes.

The display VIA performs similar functions for the display, except that the memory interface is provided for WRAM instead of SDRAM.

SDRAM

Genesis has 16 (optionally 8, 32, or 64) MBytes of SDRAM dedicated to processing. The SDRAM is accessed 64 bits at a time, at 50 MHz, for data transfers at a rate of 400 MBytes/sec. The SDRAM memory holds program code ('C80) as well as image and post-processing result data.

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NOA

The optional NOA is a neighborhood operation accelerator. It accelerates (by a factor of up to 20, over the 'C80 alone) convolutions, normalized grayscale correlation, binary or grayscale morphology, pattern matching, and lossless JPEG compression/decompression.

Grab Port Interface

Genesis can receive data from other boards (in raster format) through a 32-bit wide grab port interface capable of various data input formats (for example: 1 x 32-bit, 2 x 16-bit, 4 x 8-bit, and time-multiplexed). Data formatting on input, including subsampling and zooming, is supported by the VIA. When the board is equipped with an optional grab module, the grab port interface is also used to broadcast grabbed data simultaneously to other boards in the system.

VMChannel

The VMChannel (VESA Media Channel) is an industry standard bus for video data, with transfer rates of 132 MBytes/sec when running at 33 MHz. It is used to transfer data between the processing memory banks, and between the processing and display memory banks. It can also be used to transfer data between boards equipped with a VMChannel interface. It has the capacity to connect up to fifteen devices (for example, one main board and six processor boards).

PCI-to-PCI bridge

Using a PCI-to-PCI bridge allows a secondary PCI bus to provide on-board data transfer without involving the Host PCI bus.

Grab module

The optional grab module (on a daughter board attached to the main board) provides real-time acquisition (analog and digital) of either color or monochrome video in standard or non-standard video formats. It features four analog video input channels, each with an 8-bit analog-to-digital converter, a 32-bit digital interface (TTL/RS-422), and a look-up table (LUT). The grab module can be configured for continuous or single-frame/field/line (snapshot) acquisition, and programmed to accept progressive, interlaced, or line scan input.

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Display section and WRAM

The optional display section provides high-resolution display from memory that is physically distinct from processing memory. The display section consists of separate main (image) and overlay (VGA) frame buffers. The main frame buffer can consist of 2 or 6 MBytes of WRAM. Monochrome applications can use 2 MBytes of the main frame buffer, for resolutions up to 1600 x 1200 x 8. For displaying 24-bit true color video, 6 MBytes of the main frame buffer must be used, for resolutions up to 1600 x 1200 x 24. The overlay frame buffer provides non-destructive overlay of desktop and/or text and graphics onto the contents of the main frame buffer. The overlay frame buffer is a separate bank of 2 MBytes of WRAM, for up to a 1600 x 1200 x 8-bit pseudo-color overlay.

The display section's graphics controller (Matrox MGA-2064W) provides extremely high graphics performance in the overlay frame buffer, and supports both single and multiple monitor operation. It produces a flicker-free display at resolutions up to 1600 x 1200 (an 8-bit or 24-bit image with an 8-bit overlay) and refresh rates of up to 85 Hz.

Since data transfer from processing to display memory can take place in parallel with processing, and since images can be grabbed to processing and display memory at the same time, Genesis can provide live display of images being processed while simultaneously displaying the images being acquired.

Note that, on the Genesis-LC, display memory is used for displaying images and for buffering PCI transfers to the Host.

Dual-screen display mode

Dual-screen mode is a display configuration that consists of a Genesis board with a display section, and an external VGA board. The Genesis board is used to display the main frame buffer on one screen. The external VGA board is used to display the Host operating system's user interface on another screen. To run in dual-screen mode, you need to disable your Genesis board display (discussed in Chapter 2).

Multi-display mode

Under Windows NT, you can run in multi-display mode. Multi-display mode is a display configuration that uses Genesis boards and/or MGA Millennium boards to create one large desktop using two, three, or four screens. Multi-display mode is discussed in Chapter 3.

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Scalability

Genesis is designed for scalability. For example, incoming images are broadcast to all system processors. Additional Genesis boards are considered to be on the same system if they are connected via the grab port interface, the VMChannel, and the PCI bus (or a combination of these).

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Features of the Genesis software

The Genesis software, available separately, includes the Genesis Native Library, Matrox INTELLICAM, and various utilities. The Genesis-LC software, available separately, includes MIL-Lite, Matrox INTELLICAM, and various utilities. Also available separately are MIL and a native library developer's toolkit (Genesis Developer's Toolkit).

Genesis Native Library

The Genesis Native Library is a complete image processing, C-callable library, with board-specific functions that allow you to derive maximum benefit from the Genesis hardware. The Genesis Native Library can be used to program the Genesis main board, the Genesis processor board, or the Genesis-LC (if the Genesis-LC is used as part of a Genesis system, for example, if the Genesis-LC is used in conjunction with a main board).

MIL

MIL is a device-independent, C-callable library with an extensive set of acquisition, transfer, display, and processing commands. MIL can be used to program the Genesis main board, the Genesis processor board, or the Genesis-LC. In the case of the main board and processor board, processing is done on-board; in the case of the Genesis-LC, it is done on the Host.

MIL-Lite

MIL-Lite is a subset of MIL. It contains all of MIL's acquisition, transfer, and display commands, but none of its processing commands. MIL-Lite should be used to program the Genesis-LC when the Genesis-LC is used in a stand-alone configuration, that is, when it is not part of a Genesis system.

Genesis Developer's Toolkit

You can port your native library application from the Host CPU to the 'C80's master processor or develop your own custom 'C80 parallel processor function by programming the 'C80 directly. This can be done with the optional Genesis Developer's Toolkit, in conjunction with Texas Instruments' TMS320C8x software development tools.

INTELLICAM

A digitizer configuration format (*.dcf*) file is required to initialize the Genesis grab module to accept the video signal from your particular video source. INTELLICAM allows you to, among other things, generate and test a *.dcf* based on the general features of your video source. Note that INTELLICAM is also included with MIL.

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What you need to get started

- A PC with a Pentium processor or better, and a PCI-bus architecture.

Δ ***Important***

Your PCI system's BIOS must be able to recognize a PCI-to-PCI bridge configuration and initialize the VGA display controller residing on the other side of the PCI bridge. A list of PC platforms compatible with Genesis can be found on our web site (**http://www.matrox.com/imaging**). If you are using a system that is different from those on the tested systems list, ask your PC manufacturer if your software meets the listed requirements.

Your system BIOS must be capable of mapping the VIA's memory requirements (i.e., 128 MBytes per VIA).

We recommend that you use a PCI system with a high-performance core-logic chipset (for example, Intel 430HX or 430VX) to obtain maximum functionality and performance from your Genesis.

- One empty, **full-length** 32-bit PCI expansion slot (master capable).
- Windows NT 3.51 (or later), or DOS version 6.22 (or later). Under Windows NT, you need at least 24 MBytes of system RAM. Under DOS, you need at least 4 MBytes of system RAM.
- A CD-ROM drive and a hard disk or network drive on which to install the Genesis software.

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Inspecting the Genesis package

You should check the contents of your Genesis package when you first open it. If something is missing or damaged, contact your Matrox representative.

Standard parts

If you ordered a Genesis main board, Genesis processor board, or the Genesis-LC, you should receive the following items:

- The Genesis main board, Genesis processor board, or the Genesis-LC, with an attached PCI board retainer. Included with the Genesis main board and the Genesis-LC is the digital cable adapter board and the ribbon cable that connects either the adapter board or the optional digital data input board to the Genesis main board or to the Genesis-LC.
- The *Genesis Installation and Hardware Reference* (this document).

Available separately

You might have also ordered one or more of the following:

- Genesis software CD-ROM (GENESIS/SW/CD) or Genesis-LC software CD-ROM (MIL-LITE/CD).
- MIL-32/CD.
- Genesis Developer's Toolkit (GENESIS/DTK).
- The Matrox digital data input board (GEN-DIG-BRD/S), and the open cable (provided to allow you to build an interface cable for connecting your video source to the digital data input board).
- The open cable (DBDH68-TO-OPEN) provided to allow you to build an interface cable for connecting your video source to the digital cable adapter board.
- Board interconnect kits (GEN-BUS/...) containing backplanes used to connect multiple boards.

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Handling components

The electronic circuits in your computer and the circuits on Genesis are sensitive to static electricity and surges. Improper handling may seriously damage the circuits. Be sure to drain static electricity from your body by touching a metal fixture (or ground) before you touch any electronic component. In addition, do not let your clothing come in contact with the circuit boards or components.

▲ ***Warning***

Before you add or remove devices from your system, always **turn off** the power to your computer and all peripherals.

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Installation

The installation procedure consists of the following steps:

1. Complete the hardware installation as described in Chapter 2. If you have any problems, consult Appendix C.
2. Complete the software installation as described in Chapter 3.

Note that, when the term Host is used in this manual, it refers to your PC.

Need help?

Appendix C offers solutions to problems you might encounter. If your Genesis questions are not answered in this manual, contact your local Matrox representative, your local Matrox sales office, or Matrox headquarters (see the Customer Support section at the back of this manual).

In the unlikely event of a failure, you will find the warranty and a "Product Assistance Request" form, which outlines return conditions and procedures, at the back of this manual.

More information

For information on the Genesis utilities, see Chapters 3 and 4. For information on the Matrox MGA software, see Chapter 5. For information on the Genesis hardware, see Chapters 6, 7, and 8. If you want more technical information about Genesis, including specifications and connector pinout descriptions, see Appendix B.

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Chapter 2: Hardware Installation

This chapter explains how to install your Matrox Genesis boards in your system.

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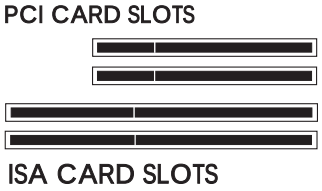
Installing your Matrox Genesis board

We know that many people like to jump right into a board installation but, before you begin, take a little time to become familiar with your new Matrox Genesis board. If you haven't read the preceding chapter, do so to make sure that you have everything you need.

Steps for installation

When you're ready, proceed with the installation as follows:

1. To avoid damaging your computer, be sure to take the following precautions before opening it:
   - Ensure that the relative humidity of your work area is at least 50%.
   - Turn off the power to your computer and peripherals.
   - Drain static electricity from your body by touching a metal part of the computer chassis before you install or remove anything from your system.
2. Remove the cover from your computer.
3. If you are installing a Genesis main board with display and want to use the Genesis main board as the main display board in single-screen mode, remove your VGA board (if your system already has one installed).
4. Check that you have an empty PCI (32-bit) slot that can host a full-length board. If you don't have an empty slot, remove a PCI board from your system to make room for your Genesis board. Take note of the slot number you choose.



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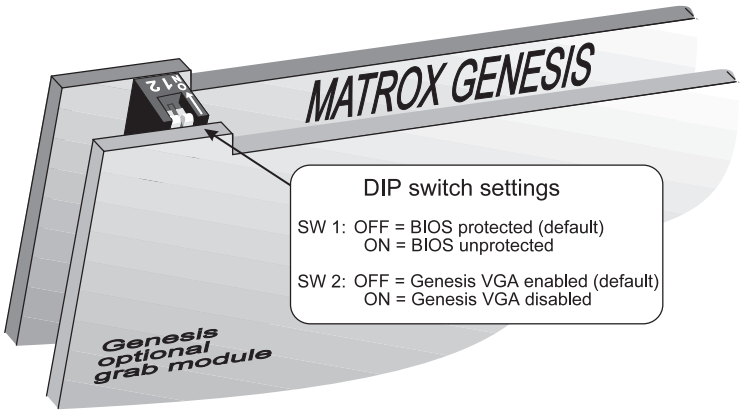
If you are installing a Genesis main board with a grab module and you want to connect the main board to the digital cable adapter board (sync and control signals only) or to the optional digital data input board (sync, control, and data signals), place the board in a PCI slot close to a wider slot (ISA or EISA). This makes it easier for you to connect your board. See Chapter 7 for details on the digital data input board and the digital cable adapter board.

▲ ***Caution***

Some computers have a large, black-ridged heat sink that prevents long boards from using most PCI board slots. Genesis **must not** touch this heat sink. So, choose a slot where the board completely avoids it. If you cannot find a suitable PCI slot, contact your computer dealer.

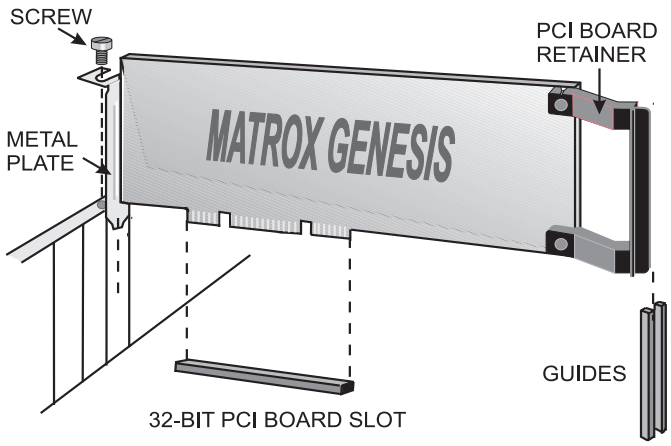
5. If there is a metal plate at the back of the selected slot, remove it. Keep the screw from the top of the plate to anchor your board once it is installed.

6. Before installing a main board, ensure that the DIP switches are set properly for the display configuration you want to use (see the next section for more detail on setting these switches). The DIP switches are located in the upper corner of the board. If your board has an optional grab module, you will note that the DIP switches are between the board and the grab module. The switches are accessible from above the board, even after installation. The default settings, which are for a single-screen configuration, are shown in the illustration below:



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7. Position Genesis over the selected PCI slot, as illustrated below. Note that the main board is inserted in the same manner with or without the optional grab module.



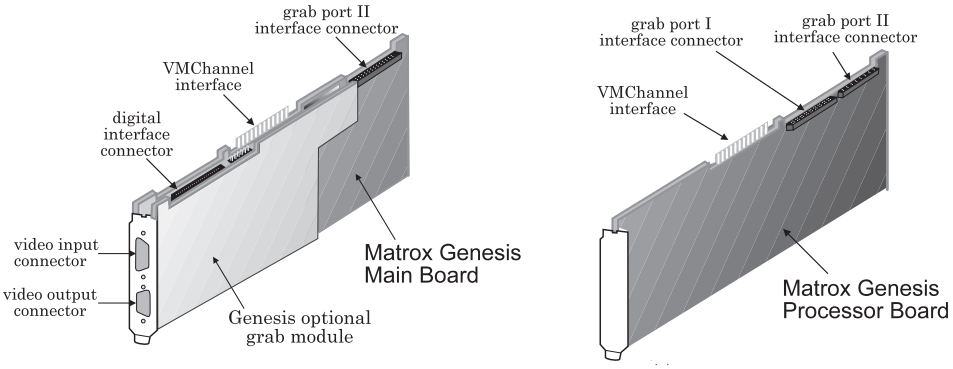
The Genesis board is inserted in the same manner with or without a grab module.

Note that Genesis has a PCI card retainer attached to it. This is because most systems have both PCI and wider slots (ISA or EISA slots). In such systems, the shorter PCI board needs a retainer to slide between the guides and hold it firmly in place. If you have a PCI system where all the slots are PCI, simply unscrew the PCI card retainer from the Genesis board.

8. Slide the board into the slot. Make sure that the attached PCI card retainer slides between the guides, and that the metal plate at the back of the board slips down into the opening left by the blank metal plate you removed in step 4 or 5.

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9. Once the board is aligned, press it firmly but carefully into the slot.
10. Anchor the board by replacing the screw that you removed in step 4 or 5.
11. Repeat steps 4 to 10 for each main board and processor board that you want to install.
12. Note that the main board has three connectors: a video output connector, a VMChannel interface, and the grab port II interface connector. If your board includes the optional grab module, it will also have a video input connector and a digital interface connector. The processor board has three connectors: a VMChannel interface, the grab port I interface connector, and the grab port II interface connector. Note that the two grab port interface connectors are similar, except that grab port I has 90 pins and grab port II has 70 pins.



The digital interface connector on the main board is used to connect to one of the digital boards (the digital cable adapter board or the optional digital data input board). See step 13 for details.

The VMChannel interface and grab port interface connectors are used to connect multiple Genesis boards (main boards and/or processor boards). See step 14 for details.

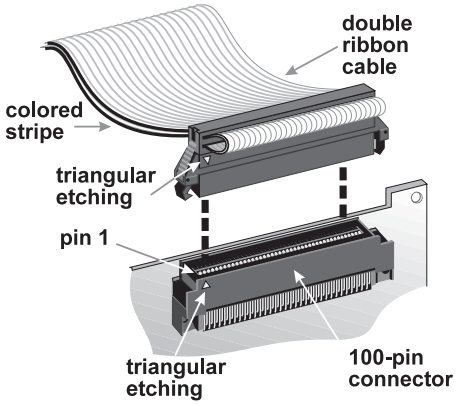
If you are not connecting one of the digital boards, or you are not connecting multiple Genesis boards, skip to step 15.

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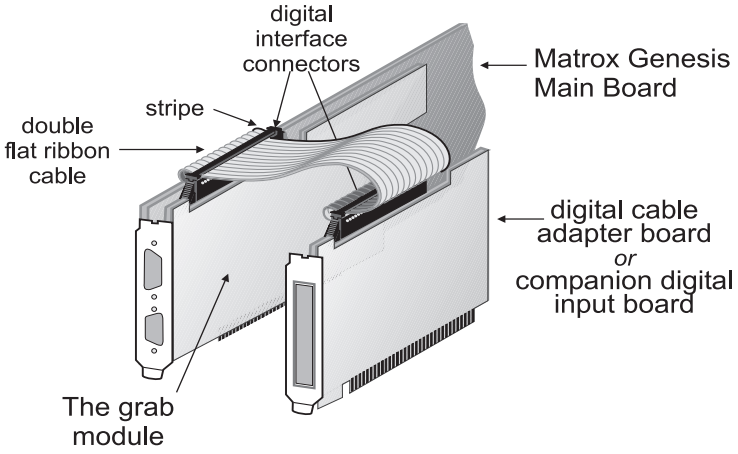
13. If you are installing the digital cable adapter board or the optional digital data input board:

    a. Install the digital data input board or the digital cable adapter board in the same way you installed the Genesis board. However, you must install the board in a wider (ISA or EISA) slot.

    b. Connect one of the flat ribbon cable's connectors to the 100-pin male connector on the digital board or on the cable adapter board. Position the connectors so that their triangular etchings face each other. The etchings indicate the location of pin 1.



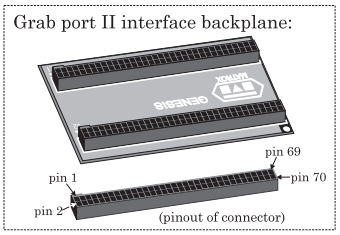
    c. Connect the other end of the flat ribbon cable to the Genesis grab module 100-pin digital input connector.

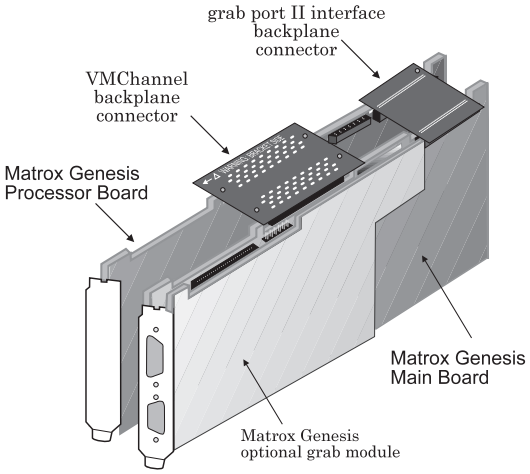


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14. If you are using multiple main boards and/or processor boards, connect the boards through their grab port II interface connectors and/or VMChannel interfaces, using board interconnect backplanes (printed circuit boards). Each backplane should be of a suitable size for the number of board connections required. Using a wider backplane, with more connectors than the number of boards to connect, will not cause any functional problems, but it will prevent you from using the slot(s) it overlaps.

    The grab port II interface connector on the backplane can be aligned with the board's connector in only one way. The VMChannel connector on the backplane must be aligned so that the arrow on the backplane points towards the mounting bracket. The connectors and their backplanes are shown below, face-up, and then flipped over and positioned to connect two boards:





Note: The above shows how to connect a processor board to a main board. The procedure is similar if you are connecting two main boards, or two processor boards.

15. Connect your monitor(s).

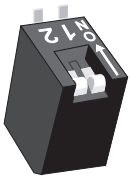
16. Attach your video source.

17. Turn on your computer.

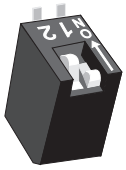
18. Install the software. After installing the software, you might want to run the CHECKPCI utility. For information about installing software and utilities, see Chapter 3.

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Choosing your display mode



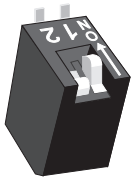
If you've purchased a Genesis main board with an optional display section, Genesis can be used as either the main VGA display controller or as a separate display. If you want to use the Genesis VGA as your main display controller in single-screen mode, you must remove or disable any other VGA in your system. If you have a built-in VGA on your motherboard and it is active, your system's BIOS will automatically disable it when Genesis is installed with its DIP Switch 2 set to **off**.



To use Genesis as a separate display, keep the required display controller enabled, and disable your Genesis main board display. To disable your Genesis board display, set its DIP Switch 2 to **on**.

If you have two Genesis main boards in your system (or a main board and an MGA board) and you want to use one of them as your main display controller and the other as a separate display, set DIP Switch 2 of one board to **on** and DIP Switch 2 of the other board to **off**.

Upgrading your VGA BIOS



If, at some time in the future, you need to upgrade your VGA BIOS, you can do so by reprogramming the Flash EPROM. This is a safe and simple operation that is accomplished with a software utility and a BIOS upgrade file. You can download a *.zip* file that contains the utility and the BIOS upgrade file from our BBS or ftp site (**ftp.matrox.com**).

Set DIP Switch 1 to **on** to allow reprogramming of the Flash EPROM. Note that you must not leave this switch **on** during normal usage since, in this state, the Flash EPROM is susceptible to being erased without warning.

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Connecting external devices

Main board

The main board has three connectors:

- A 15-pin VGA video output connector (DB-15) that sends analog video and digital synchronization signals to the monitor. This is located on the bracket of the main board.
- A 68-pin VMChannel interface used to connect multiple Genesis boards.
- The 70-pin grab port II interface connector used to connect multiple Genesis boards.

If your main board includes the optional grab module, it will have two additional connectors:

- A video input connector, made up of a 7W2 connector with two coaxial pin contacts and five regular pin contacts. This is located on the bracket of the main board.
- A 100-pin digital interface connector to which you can attach the digital cable adapter board or the optional digital data input board (using a flat ribbon cable).

Processor board

The processor board includes the VMChannel interface and the grab port II interface connector. These two connectors are identical to their counterparts found on the main board. The processor board also includes the grab port I interface connector, which is similar to the grab port II interface connector except that it has 90 pins. The grab port I interface connector can be used to connect multiple processor boards in a Genesis multi-board configuration, or can be used for interfacing to Matrox Video Products Group board(s).

Digital boards

The digital cable adapter board and the optional digital data input board each have the same type of 100-pin digital interface connector as is used on the Genesis board (for inter-board connection). In addition, each digital board contains a digital video input connector.

❖ For a detailed description of the above connectors, refer to Appendix B.

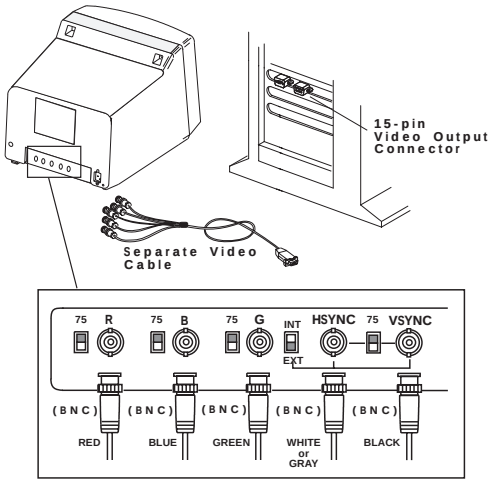
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Connecting to a monitor

Genesis works with VGA and high-resolution monitors. Use the video cable supplied with your monitor to connect the video output of Genesis.

The steps to attach your monitor to your Genesis board are as follows:

1. If your monitor has input impedance switches, set the switches for the red, green, and blue inputs to 75 ohms, as shown in the illustration below. Set the synchronization inputs according to your monitor's manual. In most cases, the synchronization should be set to high impedance.



2. Connect the display monitor to the 15-pin female video-output connector on the main board. If your monitor has a DB-15 connector, use the standard DB-15 to DB-15 cable. Otherwise, use the DB-15 to 5 BNC cable that is usually provided with your monitor. If you are using the DB-15 to 5 BNC cable, connect the red, green, and blue wires to the corresponding guns on your monitor. The black wire usually carries the vertical synchronization signal, while the white or gray wire usually carries the horizontal synchronization signal.



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Connecting to a video source

Connecting to an analog video source

Genesis supports a wide variety of analog video sources. You can interface to these video sources through the video input connector.

There are two optional cables with which you can attach an analog video source:

- The IMG-7W2-TO-5BNC cable connects to the video input connector. It has five BNC connectors, and a female 7W2 connector with 2 coaxial receptacles and five contacts.

  This cable allows you to connect up to four analog video sources and a trigger input. The cable wires are color-coded, as follows:

  - RED wire - Channel 0 or Red channel
  - GREEN wire - Channel 1 or Green channel
  - BLUE wire - Channel 2 or Blue channel
  - BLACK wire - Channel 3
  - GRAY or YELLOW wire - Trigger input (TTL)
- The IMG-7W2-TO-1BNC cable connects to the video input connector. It has one BNC connector (CHANNEL 0), and a female connector with 2 coaxial receptacles and five contacts.

Connecting to a digital video source

To connect a digital video source to your optional Genesis digital data input board, connect a DBDH100-TO-OPEN cable with a high-density, SCSI-2 type, D-shell, 100-pin plug to the board's 100-pin receptacle.

To connect a digital video source to your Genesis digital cable adapter board, connect a DBDH68-TO-OPEN cable with a high-density, SCSI-2 type, D-shell, 68-pin plug to the module's 68-pin receptacle.

These cables have open wires on one end so that you can assemble the connector that is appropriate for your particular video source.

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Chapter 3: Software

This chapter explains how to install the Genesis software and how to use the various utilities.

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Installing Genesis software

To install the software, place the appropriate CD-ROM (GENESIS/SW/CD, MIL-LITE/CD, or MIL-32/CD) in a CD-ROM drive. Then,

- under Windows, run the *setup.exe* program on the CD-ROM
- under DOS, type at the prompt, using the appropriate drive letter,

```
d:\install
```

During installation, you can choose to install one or more of the available software. Note that you should install the MGA WIN NT display driver if you are using Genesis as the main display controller under Windows NT. If MGA drivers are already installed on your system, you will be prompted to choose between the currently installed drivers and the new ones. You should choose to install the new ones.

After installation

After installation, read the *readme.txt* file for Genesis (in the \GENESIS\DOC directory) or the *read.me* file for MIL/MIL-Lite (in the \MIL directory). These files describe where library files are located, how to compile and run examples, last-minute information, compatibility issues, etc.

A note about the MGA

In the sections that follow, the Matrox MGA Millennium is mentioned, especially in reference to the utilities. This is because the optional display section of Genesis uses the same graphics controller as the Millennium and, as a result, Millennium software (the **MGA Power Desk**) works with Genesis. The **MGA Power Desk** is described in Chapter 5.

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MGA WIN NT display driver

If installed, the MGA WIN NT display driver can be used to configure the Genesis overlay (VGA) frame buffer in an 8-bit (256 colors) display mode, at resolutions ranging from 640 x 480 to 1600 x 1200. The main (image) frame buffer is automatically set to the same resolution.

Changing resolutions

If necessary, you can change display resolution after installation by running the **Display** applet from the **Control Panel** and then doing either of the following:

- Clicking on the **List All Modes...** button from the **Settings** tab to obtain a list of all the modes that are available for Genesis. Select a different mode from the displayed list. Click on the **OK** button to exit from the current menu.
- Using the **Desktop Area** controls from the **Settings** tab.

Use the **Test** button to ensure that your monitor supports the new mode. You will have to reboot your system for the new settings to take effect.

Monitor configuration for Windows NT

By default, the MGA WIN NT display driver assumes that you have a 60-Hz monitor. If your monitor is capable of higher refresh rates, you can customize your monitor as follows:

1. From the **Control Panel**, run the **Display** applet.
2. From the **MGA Monitor** tab, select the appropriate monitor, or one with a maximum refresh rate that matches your monitor. An *mga.inf* file is created in the \SYSTEMROOT\SYSTEM32 directory.

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3. To ensure that the newly created *mga.inf* file is suitable for your monitor:

   a. From **Control Panel**, run the **Display** applet.

   b. From the **Settings** tab, click on the **List All Modes...** button. From the presented list, select the resolution and pixel depth that you want to test. Resolutions exceeding that of the selected monitor do not appear in the list. Deleting the *mga.inf* file will remove all monitor limits on the resolution; however, the refresh rate will default to 60 Hz.

   c. Click on the **Test** button to ensure that the video parameters selected are appropriate for the monitor.

   d. If your monitor does not display a stable test screen, the parameters set by *mga.inf* are not suitable for your monitor. Click on the **Cancel** button to close the **Display** applet, then run the **Display** applet again and select another monitor. Repeat the test.

4. When the monitor timings are set correctly, restart Windows for the new *mga.inf* settings to take effect.

For more information, refer to the *readme.txt* file in the \GENESIS\DOC directory.

Multi-display mode

Under Windows NT, you can run in multi-display mode. Multi-display mode is a multi-board configuration that uses Genesis boards and/or MGA Millennium boards to create one large desktop using two, three, or four screens.

To set up a multi-display configuration:

1. From the **Control Panel**, run the **Display** applet.

2. From the **Settings** tab, click on the **List All Modes...** button.

   A list of resolution modes, including several double-size modes, will be displayed.

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3. Choose one of the double-size modes. This gives you a desktop twice, three times, or four times the size of one that can be achieved using only one monitor.

   - In multi-display mode, the *mga.inf* monitor settings affect all monitors. The monitor that you select should be compatible with the least-capable monitor in your system.

Notes about multi-display mode

- To use multi-display mode, you need version 1.20 or later of the MGA Millennium display driver for two screens, version 2.0 or later for three screens, and version 2.2 for four screens.
- MIL (or MIL-Lite) is required to transparently track window displacement from one board to another.

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Genesis utilities

The Genesis software includes the following utilities: GENINTER, GENPIXV, GENKEY, GENVCFLD, GENFPGA, GENSNOOP, GENANA, GENMEMV, GENCOUT, and CHECKPCI. These utilities are installed when you install the Genesis Native Library.

Conventions

The following conventions are used in the presentation of the utilities:

- Items enclosed in square brackets, [ ], denote optional parameters. (Do not include the brackets when calling the command).
- Items in *italic* denote parameters.

Readme files

For additional information on a utility, consult the *readme.txt* file in the directory where the utility is located.

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GENINTER

Synopsis Interactively experiment with Genesis Native Library commands.

Command GENINTER <identifier> [parameter]

Location GENINTER is located in one of the following directories:

- under Windows NT: \GENESIS\UTIL\WINNT
- under DOS: \GENESIS\UTIL\DOS

Description The Genesis Native Library Interpreter (GENINTER) is an interactive interpreter that allows you to execute any Genesis Native Library command on the command line without having to recompile. Because the syntax of GENINTER is similar to that of the C language, you can use GENINTER to develop C programs based on command lists.

GENINTER is described in detail in Chapter 4. In addition, on-line help is included.

Parameters The *identifier* parameter specifies the name of an internal command, a Native Library command, a macro, or a command list; see Chapter 4 for details.

The *parameter* parameter specifies the list of parameters corresponding to the entered command; see Chapter 4 for details.

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GENPIXV

Synopsis View and/or modify a buffer in a pixel-value format.

Command
GENPIXV <BufId> *or*
GENPIXV <IM_DISP> <System> <Display> *or*
GENPIXV <IM_DISP_MONO> <System> <Display> *or*
GENPIXV <IM_DISP_COLOR> <System> <Display> *or*
GENPIXV <IM_DISP_RED> <System> <Display> *or*
GENPIXV <IM_DISP_GREEN> <System> <Display> *or*
GENPIXV <IM_DISP_BLUE> <System> <Display>

Location GENPIXV is located in one of the following directories:

- under Windows NT: \GENESIS\UTIL\WINNT
- under DOS: \GENESIS\UTIL\DOS

Description The GENPIXV utility displays, in a pixel-value format, the contents of a previously allocated buffer (GENPIXV <BufId>) or the contents of the main (image) frame buffer of a display section (GENPIXV <IM_DISP ...).

To view a different buffer without exiting the utility, press F7.

For full-screen display of a buffer, click on the button at the top-left corner of the pixel-view window, or press F3.

A multiple-band buffer can be specified, although only one band at a time can be displayed on-screen. Press F1 to switch between the bands of the buffer.

A child buffer can be specified. The parent buffer is automatically scrolled on start-up, so that the child is displayed in the user window. The parent buffer is displayed highlighted, with the child buffer not highlighted. Note that, since the parent buffer is also displayed, you can see how the child's boundary pixels are related to its surrounding parent pixels.

Modes of operation

GENPIXV has three modes of operation:

standard view	The buffer is viewable only.
editing	Single pixels of the buffer can be given new values.
surface editing	A block of one or more pixels can be given a new value.

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The default mode is standard view. Press F4 to enter editing mode. Press F5 or click on the left mouse button to enter surface editing mode. To exit any mode, press the "q", "Q" or "Esc" key. If in one of the editing modes, exiting returns the utility to standard view.

Editing mode

In editing mode, the value of the pixel under the cursor can be dynamically altered by keying a new pixel value.

Surface editing mode

In surface editing mode, the value of each pixel within a delimited surface can be altered to a specified pixel value. To use surface editing mode, do one of the following:

- Enter editing mode. Position the cursor over the pixel to modify, or over a corner pixel of a surface to modify. Press F5 to enter surface editing mode. Displace the cursor to define the required surface or use the Goto facility to define the required surface, key the new value, then press "Enter" to confirm the change and return to standard view. See below for details on the Goto facility.
- Position the mouse cursor over the corner pixel of a surface to modify, click the left mouse button to enter surface editing mode, drag the mouse to delimit the required surface, then release and enter the new value at the prompt. Press "Enter" to confirm ("Esc" to cancel) the change and return to standard view.
- Position the mouse cursor over a pixel to modify, click the left mouse button once to enter surface editing mode, then release and enter the new value at the prompt. Press "Enter" to confirm ("Esc" to cancel) the change and return to standard view. (Note, single-pixel changes are most efficiently done directly in editing mode.)
  - The first method is the only choice possible if you are **not** using a mouse. It is also the only choice that allows you to use the Goto facility to define the required surface.

Editing child buffers

When editing a child buffer in either editing mode, only pixels within the child's boundaries can be modified. A surface greater than the child buffer can be highlighted, but only pixels within the child buffer will be assigned the new value.

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Moving through a buffer

You can use the mouse to move through a buffer (for quick scrolling, click on the arrows at the ends of the scroll bars). In addition to the mouse, you can use the following keys:

Key	Action
arrow keys	Dependent on the active mode: standard view - Scroll a single row or column. editing - Move between pixels. surface editing - Extend the surface.
PageUp/PageDown, Tab, backspace, Shift + Tab	Full-screen scroll.
Ctrl + PageUp/PageDown, Ctrl + →, Ctrl + ←	Jump to an edge of the buffer.
Home	Jump to upper-left corner (lowest coordinates) of the buffer.
End	Jump to lower-right corner (highest coordinates) of the buffer.

Goto

GENPIXV offers a Goto facility that allows you to jump to a specific pixel location in the buffer. Press F2 or click the right mouse button to trigger the Goto. Then, use the arrow keys or the "PageUp/PageDown" keys to indicate the desired pixel coordinates. Press "Enter" to perform the jump. When in surface editing mode, a Goto extends the surface boundary to the specified location. To quickly select the entire buffer surface, start at one corner and jump to the opposite corner. To call up the pixel value modification prompt after performing a jump, press on a numeric key or on a letter key from A through F.

Buffer info

To obtain information on the buffer you are currently viewing, press F6. The pixel format and location are #defines whose values can be obtained from the API header. The band address specified is the Host address of the current band, not a local address.

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Parameters

The *BufId* parameter specifies the identifier of the previously allocated buffer you want to view/modify. The buffer identifier must be expressed in hexadecimal form (for example, 0x11000e).

If you want to view/modify the main frame buffer of a display section, use one of the following instead of the <*BufId*> parameter:

IM_DISP	View/modify the default main frame buffer of a display.
IM_DISP_MONO	View/modify the main frame buffer of a monochrome display.
IM_DISP_COLOR	View/modify the main frame buffer of a color display.
IM_DISP_RED	View/modify only the red band of a color display.
IM_DISP_GREEN	View/modify only the green band of a color display.
IM_DISP_BLUE	View/modify only the blue band of a color display.

The *System* parameter specifies the number of the system (0, 1, 2, ..., 14) on which the display is located, if you are viewing/modifying the main frame buffer of a display. If you are viewing/modifying a previously allocated buffer, do not use this parameter.

The *Display* parameter specifies the number of the display (0, 1, 2, ..., 14), if you are viewing/modifying the main frame buffer of a display. Note that the display number is not the same as the node number. If you are viewing/modifying a previously allocated buffer, do not use this parameter.

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GENKEY

Synopsis Set the keying mode.

Command
GENKEY <System> <Display> -k <color> *or*
GENKEY <System> <Display> -i *or*
GENKEY <System> <Display> -v

Location GENKEY is located in one of the following directories:

- under Windows NT: \GENESIS\UTIL\WINNT
- under DOS: \GENESIS\UTIL\DOS

Description The GENKEY utility does one of the following:

- Overlays the main (image) frame buffer with the overlay (VGA) frame buffer, making the specified color transparent:
  GENKEY <System> <Display> -k <color>
- Displays only the main frame buffer:
  GENKEY <System> <Display> -i
- Displays only the overlay frame buffer:
  GENKEY <System> <Display> -v

Note that, in dual-screen mode, the *imDevAlloc()* function downloads a default display configuration file (*.vcf*) and keying is set to display only the main frame buffer. In single-screen mode, no *.vcf* file is downloaded and keying is set to display only the overlay frame buffer. In multi-display mode, no *.vcf* file is downloaded and keying is left as is.

Parameters The *System* parameter specifies the number of the system (0, 1, 2, ..., 14) on which the display is located.

The *Display* parameter specifies the number of the display (0, 1, 2, ..., 14) in the system. Note that the display number is not the same as the node number.

The *color* parameter specifies the color to make transparent when overlaying the main frame buffer. The *color* parameter can be set to any value between 0 and 255.

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Note The MGA chip on the Genesis display section can be run in VGA mode or Power Graphics mode. In VGA mode, only the overlay frame buffer can be displayed, so the GENKEY utility cannot be used. In Power Graphics mode, both the overlay and main frame buffers can be displayed, so GENKEY can be used.

In dual-screen mode under DOS, the overlay frame buffer is not initialized by the Native Library. Therefore, "display VGA only" or "key on VGA color" might not give the appropriate result.

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GENVCFLD

Synopsis Associate a display configuration file with a specific display.

Command GENVCFLD <filename> <System> <Display>

Location GENVCFLD is located in the following directory:

- under Windows NT: \GENESIS\UTIL\WINNT
- under DOS: \GENESIS\UTIL\DOS

Description The GENVCFLD utility associates a display configuration file (*.vcf*) with a specific display.

Note that, on Genesis, the MGA only supports 8 bits per pixel for the overlay (VGA) frame buffer. In dual-screen mode, use the GENVCFLD utility to configure the overlay frame buffer to the desired 8-bit resolution. The main (image) frame buffer resolution is automatically set to be the same as the overlay resolution.

Parameters The *filename* parameter specifies the name of the display configuration file.

The *System* parameter specifies the number of the system (0, 1, 2, ..., 14) on which the display is located.

The *Display* parameter specifies the number of the display (0, 1, 2, ..., 14) in the system. Note that the display number is not the same as the node number.

Note In dual-screen mode, the *imDevAlloc()* function downloads a default *.vcf* file. In single-screen mode and multi-display mode, no *.vcf* file is downloaded.

The MGA chip on the Genesis display section can be run in VGA mode or Power Graphics mode. The GENVCFLD utility can only be used in Power Graphics mode.

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GENFPGA

Synopsis Download the serial bitstream file for the Genesis programmable logic device(s).

Command GENFPGA <Filename> [System] [Node]

Location GENFPGA is located in the following directory:

- under Windows NT: \GENESIS\UTIL\WINNT
- under DOS: \GENESIS\UTIL\DOS

Description The GENFPGA utility downloads the serial bitstream file for the Genesis programmable logic device(s) to:

- A specific node on a specific system.
- All nodes on a specific system.
- All nodes on all systems.

Note that the same file is downloaded if you are downloading to more than one node.

Parameters The *Filename* parameter specifies the name of the file containing the configuration data required for the Genesis programmable logic device(s). This can be for any logic device (for example, grab logic device).

The *System* parameter specifies the number of the system (0, 1, 2, ..., 14), if you are downloading to one or all nodes on a system. If you are downloading to all nodes on all systems, set the *System* parameter to -1 (or omit it).

The *Node* parameter specifies the number of the node (0, 1, 2, ..., 14), if you are downloading to a specific node on a system. If you are downloading to all nodes on a specific system, the *Node* parameter must be omitted. If you are downloading to all nodes on all systems (i.e. the *System* parameter is set to -1), the *Node* parameter is irrelevant and will be ignored if passed to the utility.

Note This function is implicit when calling the *imDevAlloc()* function.

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GENSNOOP

Synopsis Check on the status of processing operations.

Command GENSNOOP

Location GENSNOOP is located in the following directory:

- under Windows NT: \GENESIS\UTIL\WINNT

Description The GENSNOOP utility dynamically displays the status of all active processing operations.

The dynamic display includes: **Status**, **Processing time**, **Thread identifier**, **Command name**, **Command parameters**, **Errors**, and **Memory left**.

More than one copy of GENSNOOP can be open at the same time, to view different nodes separately.

For more information about this utility, refer to its on-line help.

Note This utility is available under Windows NT only.

The GENANA utility graphically displays the sequence of events recorded with GENSNOOP.

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GENANA

Synopsis Graphically display the sequence of events recorded with GENSNOOP.

Command GENANA

Location GENANA is located in the following directory:

- under Windows NT: \GENESIS\UTIL\WINNT

Description The GENANA utility graphically displays the sequence of events recorded with the GENSNOOP utility. The GENANA utility can be useful while debugging an application.

For more information about this utility, refer to its on-line help.

Note This utility is available under Windows NT only.

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GENMEMV

Synopsis Graphically display how memory is mapped on all Genesis systems.

Command GENMEMV

Location GENMEMV is located in the following directory:

- under Windows NT: \GENESIS\UTIL\WINNT

Description The GENMEMV utility graphically displays how memory is mapped on all Genesis systems. This utility can be useful while debugging an application.

For more information about this utility, refer to its on-line help.

Note This utility is available under Windows NT only.

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GENCOUT

Synopsis Print internal message to console.

Command GENCOUT

Location GENCOUT is located in the following directory:

- under Windows NT: \GENESIS\UTIL\WINNT

Description The GENCOUT utility is a console output-handler for Genesis Native Library internal print messages. If enabled, this utility is automatically called by *imDevAlloc()* and closed by *imDevFree()*.

Note This utility is available under Windows NT only.

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CHECKPCI

Synopsis Report any conflicts between devices mapped onto the PCI bus.

Command CHECKPCI

Location CHECKPCI is located in the following directory:

- under Windows NT: \GENESIS\UTIL\WINNT
- under DOS: \GENESIS\UTIL\DOS

Description The CHECKPCI utility checks all devices mapped onto the PCI bus and reports any conflicts between these devices. This utility can be useful if you are having problems with your Genesis board (for example, if the board keeps stalling whenever you grab).

Note that this utility does not report conflicts between devices mapped onto a bus other than the PCI bus. For example, it does not report conflicts between devices mapped onto ISA and EISA buses.

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Chapter 4: The Genesis Native Library Interpreter

The Genesis Native Library interpreter enables you to use Genesis Native Library functions without a C compiler.

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What is the Genesis Native Library Interpreter?

The Genesis Native Library Interpreter (GENINTER) is an interactive interpreter that accesses all the functions provided with the Genesis Native Library. It enables you to experiment with the Native Library functions without having to recompile every time a change is made.

Easy to use

Because the syntax of GENINTER is similar to that of the C language, experimenting with the functions available in the Native Library is easy for programmers experienced with C. This similarity of programming syntax allows you to develop C programs based on command lists (see the *Command lists* section for further details).

Help utility

If you need information about a specific Native Library function, there is a help utility that contains descriptions of all the available interpreter commands. The INTER_HELP environment variable must be set to the path containing the interpreter help files. Alternatively, the HELPPATH command can be used to specify this path by enclosing it in quotes. See "Miscellaneous commands" in the *Advanced features* section for further details about INTER_HELP and HELPPATH.

DOS and Windows

GENINTER exists in two versions: GENINTER for DOS and GENINTER for Windows. Both versions are fully compatible. In other words, you can use a command list created in a particular version in either of the versions.

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Getting started

Installation procedures

If you want to use GENINTER for DOS, make sure that you have installed the Genesis Native Library under DOS. If you want to use GENINTER for Windows, make sure that you have installed the Genesis Native Library under Windows. Note that you can have both versions of GENINTER installed on your computer. For information about installing the Genesis Native Library, see Chapter 3.

GENINTER for DOS

GENINTER for DOS uses ANSI escape sequences. Make sure that the *ansi.sys* driver is installed on your system before invoking GENINTER. You will find GENINTER in the \GENESIS\GENINTER\DOS directory.

GENINTER for Windows

To run GENINTER for Windows, make sure that Windows can access *gen*.dll* files. These files are located in the \GENESIS\LIBRARY\WINDOWS*Compiler*\DLL directory (where *Compiler* refers to your specific compiler). You can ensure that Windows can access these files by including the directory in the PATH environment variable. Note, however, that you do not have to include the directory in the PATH environment variable if *gen*.dll* files were placed directly in your Windows directory upon installation.

For a list of supported compilers, refer to the *readme.txt* file in the \GENESIS\DOC directory.

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Once you have ensured that Windows can access *gen*.dll* files, create a new program item for GENINTER. To do so, select **New** from Program Manager's **File** menu, then **Program Item** from the presented sub-menu. Enter the following in the presented dialog box:

Description: GENINTER
Command Line:
GENESIS\GENINTER\WINDOWS\GENINTER.EXE
Working Directory: GENESIS\GENINTER\WINDOWS
Shortcut Key: None

The GENINTER icon should appear.

Working with NT 4.0

If you're working with Windows NT 4.0, you can create a shortcut to GENINTER on your desktop. To do so, select **Explore** after clicking the right mouse button on the **Start** button. From the **Exploring** dialog box, select the GENESIS\GENINTER\WINDOWS directory. Select the *geninter.exe* file and drag it to your desktop. Press the **Ctrl** key and drop the file on your desktop. Pressing the **Ctrl** key ensures that you are placing a copy of the *geninter.exe* file on your desktop and not the *geninter.exe* file itself.

The GENINTER shortcut icon should appear.

Invoking GENINTER

You can invoke GENINTER by clicking on the GENINTER icon under the Windows' environment, or by typing the following at the DOS prompt:

```
GENINTER [filename[parameter...]
```

If a file is specified, the commands previously saved in that file are executed before you are prompted for your first command, and the parameters are passed to the file like any other command list (see the *Command lists* section for further details).

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If no file is specified, the commands in the *geninter.ini* file are executed before you are prompted for your first command. If the *geninter.ini* file cannot be found, you are simply prompted for your first command.

For more information on file handling, see "File handling" in the *Advanced features* section.

To quit the program, type "QUIT" at the prompt.

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Genesis Native Library examples

A sample command list, *example1.cl*, allows you to test the installation process and become familiar with running a Genesis Native Library application.

If you're working with Windows NT, use the GENKEY utility to set the keying color before you load the sample command list (see *Chapter 3* for details on GENKEY). Load the sample command list from disk by typing the following command at the GENINTER prompt:

```
loadcl example1 "..\examples\example1.cl"
```

Then, type the following at the GENINTER prompt:

```
example1
```

example1.cl

```
; Allocate a buffer, load a .tif file into it, allocate a child on the display,
; then transfer the contents of the buffer to the display

long dev
long thread
long srcbuf
long dstbuf

imDevAlloc 0 0 NULL IM_DEFAULT &dev
imThrAlloc dev 0 &thread

imBufRestore thread "baboon.tif" IM_TIFF IM_PROC &srcbuf
imBufChild thread IM_DISP_MONO 0 0 512 480 &dstbuf
imBufCopy thread srcbuf dstbuf 0 0

GenPixv dstbuf

imBufFree thread dstbuf
imBufFree thread srcbuf
imThrFree thread
imDevFree dev
freedev
freethread
freesrcbuf
freedstbuf
```

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Editing example1.cl

After loading *example1.cl*, you can edit it by typing the following at the prompt:

```
editcl example1
```

Genesis Native Library examples

Several examples are provided with the Genesis Native Library. They can be run using the procedure described above. These examples can help you learn the Genesis Native Library functions without having to set up a programming environment.

Setup

You can modify the sample programs to suit your needs by editing the *gensetup.cl* text file. The *gensetup.cl* text file is located in the \GENESIS\GENINTER\CMDLISTS directory.

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Genesis Native Library standard types and macros

GENINTER provides the following standard Genesis Native Library types and macros.

Name: **CHAR**, **SHORT**, **LONG**, **DOUBLE**

Synopsis: The CHAR, SHORT, LONG, and DOUBLE types are analogous to the C language variable types.

Usage:	CHAR <identifier>	Variable declaration
	SHORT <identifier>	Variable declaration
	LONG <identifier>	Variable declaration
	DOUBLE <identifier>	Variable declaration
	<identifier>	To pass the value to a function
	&<identifier>	To pass the address to a function
	SET<identifier> <value>	To assign a value to the variable
	GET<identifier>	To print the variable content
	free<identifier>	Free space allocated with variable

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Help

For a brief description of a command, including its parameters and their data types, enter the following at the command line:

```
help [identifier]
```

If a command identifier is entered, the grammatical structure, usage, and parameter data type for the command will be printed. By entering the first letters of a series of commands, GENINTER will print out information about all commands starting with those letters. For example, by typing "imBuf", GENINTER will list all functions whose names start with "imBuf". This will allow you to obtain a list of the functions of the Native Library's buffer management module.

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Syntax

Notational convention

This chapter uses the following notation:

"char"	Characters between quotation marks are used to define a fixed value item. Example: "6"
<item>	An item enclosed in <> indicates a parameter that you must include. Example: loadmacro <filename>
[item]	An item enclosed in square brackets indicates an optional parameter. Example: description [command]
item...	Three dots following an item indicate that more items having the same form can be entered. Example: execcl <filename> [parameter...]
key names	Key names separated by a plus sign (+) indicate that you must press both keys at the same time. Example: Ctrl+PgUp

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Command definition

When you invoke GENINTER, the specified commands (as explained in the *Invoking GENINTER* section) will execute. You will then be prompted for a command at the > prompt.

There are two types of commands in GENINTER: internal commands (commands already defined in the interpreter that do not directly affect the board) and library function commands (commands defined in the library that directly affect the board).

At the prompt, you will be prompted to type something similar to the following:

```
<identifier> [parameter...]
```

<Identifier> refers to an internal command, a library function command, a macro, or the name of a command list (see the *Interpreter Syntax* section for the identifier syntax). The list of all reserved command identifiers can be obtained by typing the *RESERVED* command at the prompt.

[Parameter...] refers to a list of parameters corresponding to the entered command.

The command identifier and all the parameters on the command line must be separated by at least one space (spaces between quotation marks are ignored).

Other considerations

When you enter a command, you don't have to enter the whole command name. You need only type the first few characters that will differentiate it from any other command.

The interpreter is **not** case-sensitive (like DOS), enabling you to enter commands either in uppercase or lowercase characters, or a mixture of both.

If the command could not be processed because an error occurred, an error message will be printed.

If the command has been processed correctly, the return value will be printed (if there is a return value). You will then be prompted for another command.

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Parameter definition

GENINTER has a very flexible way of defining parameters. A parameter can be defined as a unary expression, a string, an identifier, or a block.

Here is the parameter syntax:

parameter = <unary_exp *or* string *or* identifier *or* block>

Unary expression

A unary expression is a unary operator followed by a term:

unary_exp = [unary_op] <term>

Unary operators

The available unary operators are:

unary_op = <! *or* ~ *or* + *or* ->

Operator	Function
!	Logical NOT
~	Bitwise complement
+	Unary PLUS
-	Unary MINUS

Term

You can define a term as a constant, a binary expression, or as a command. Binary expressions must be enclosed in parentheses; commands must be enclosed in square brackets.

term = <const *or* "(" binary_exp ")" *or* "[" command "]">

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Constants

A constant can be either an integer or a character:

const = <int_const *or* char_const>

By default, all integer constants are decimal. It is also possible to enter hexadecimal, binary, and DOUBLE values on the command line. Hexadecimal values have a prefix of 0x (or 0X), binary values have a prefix of 0b (or 0B), and DOUBLE values have a prefix of 0d (or 0D).

int_const = <<dec_digit> [dec_digit...] *or*
<0B | 0b> <bin_digit> [bin_digit...] *or*
<0X | 0x> < hex_digit> [hex_digit...] *or*
<0D | 0d> <DOUBLE_digit> [DOUBLE_digit...]>

Character constants can also be used by putting any single representable character between single quotation marks. A representable character is any character that is visible on the screen, such as a letter of the alphabet or an asterisk.

char_const = <' char '>

Binary expression

A binary expression is defined as a unary expression followed by an optional binary operator and/or another unary expression:

binary_exp = <unary_exp> [<binary_op unary_exp>...]

The available binary operators are:

binary_op = <* *or* / *or* % *or* + *or* - *or* << *or* >> *or* == *or* < *or*
> *or* != *or* <= *or* >= *or* & *or* | *or* ^ *or* && *or* | |>

All these operators conform to C programming grammar.

Operator	Function
*	Multiplication
/	Division
%	Remainder
+	Addition
-	Subtraction
<<	Left shift
>>	Right shift
==	Equality

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<	Less than
>	Greater than
!=	Inequality
<=	Less than or equal to
>=	Greater than or equal to
&	Bitwise AND
|	Bitwise OR
^	Bitwise XOR
&&	Logical AND
||	Logical OR

Here are some examples of binary expressions:

```
-123
 0x1FFB0
 ( (0x03F0 >> 2) * 3 )
-( (3 + (0x5F & 'A') * 5) && ! ('*' >= 0b1111011) )
```

All expressions are evaluated from right to left, with no precedence on the operations except for those enclosed in parentheses. All the values are converted to 32-bit signed integers, and all the operations are performed on 32-bit signed integers. GENINTER does **not** detect overflows on operations and therefore will allow erroneous results to be passed to functions. A *"Parameter out of range"* error occurs if the input value for a given operation does not fall within the limits permitted for this kind of parameter.

Operations are also possible on #1 ... #9 expressions (see the *Command lists* section for more information), and on '_i' expressions (see the *Loop* section for more information).

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Command names

Command names used as terms are defined as follows:

command = <identifier> [parameter...]

Here is an example of the usage of the *SETNBR* command. This function assigns a numerical value to a specified identifier.

```
> SetNbr n 3
> SetNbr m 2
> SetNbr n ( [ GetNbr n ] + [ GetNbr m ] )
> GetNbr n
Return DWORD = 5
>
```

In the above example, the *GETNBR* command returns a numeric value that can be used as a constant in a binary expression or used directly as a parameter. All the commands used in a parameter definition must return a value. This value can be a number or a string, but a string cannot be used in a binary expression.

String

As mentioned, a parameter can also be a string. A string is defined as follows:

string = <" [char...] " *or* "[command]">

You can use quotation marks (") to pass a whole string as a parameter. When a string is enclosed in quotation marks, it is considered as one parameter. All characters enclosed in quotation marks are **not** converted to lowercase, and macros are **not** expanded, but #1 ... #9 expressions are replaced by their corresponding values.

Note that a string can also be a command, but the command must return a string.

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Here is an example of the string parameter used with the *SETSTR* command. This function assigns a string value to a specified identifier.

```
> SetStr s0 "ABCD"
> SetStr s1 "EFGH"
> GetStr s0
Return STRING = ABCD
> SetStr s0 [ GetStr s1 ]
> GetStr s0
Return STRING = EFGH
>
```

The interpreter checks for parameter type mismatches. If you try to pass a string parameter where only a numerical parameter can be specified, GENINTER will print an error message.

Identifier

You can also use an identifier as a parameter. The identifier syntax is a letter followed by some other letters or numbers (see the *Interpreter Syntax* section).

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Editing

GENINTER provides a line editor, similar to the DOS command-line editor, for entering commands. The keys that provide special functionality are:

Left arrow	Moves the cursor left one character; stops at the beginning of the line.
Right arrow	Moves the cursor right one character; stops at the end of the line.
Home	Moves the cursor to the beginning of the line.
End	Moves the cursor to the end of the line.
Ctrl+Left arrow	Moves the cursor left to the start of the nearest word.
Ctrl+Right arrow	Moves the cursor right to the start of the nearest word.
Ctrl+PgUp	Clears the history buffer; see the *History* section.
Up arrow	Moves up in the history buffer; see the *History* section.
Down arrow	Moves down in the history buffer; see the *History* section.
Esc	Erases the entire current line and moves the cursor to the beginning of the line.
Delete	Erases the character at the current cursor location; moves the rest of the line one character to the left.
Backspace	Erases the character to the left of the cursor; moves the cursor and the rest of the line one character to the left.
Ctrl+End	Deletes from the cursor to the end of the line.
Insert	Toggles between insert and overwrite mode and changes the cursor shape accordingly (see next page).
Enter	Ends the user input and calls the GENINTER parser to process the command line (the cursor can be at any position on the line).

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Insert/overwrite mode

In insert mode, each character entered moves the rest of the line (to the right of the cursor) one character to the right to make room for the new character. In overwrite mode, any character entered replaces the character currently at the cursor position. The shape of the cursor indicates which mode is currently active.

History

All the commands you enter are saved in a list, called a history buffer, of a fixed length (50 entries). Every time a new command is entered, it is placed at the bottom of the list. When the list is full, any new entry overwrites the entry at the bottom of the list.

The "Up" arrow key recalls the previous command from the list. The "Down" arrow key recalls the next command from the list. The "Ctrl+PgUp" key clears all the commands from the list. The cursor can be at any position on the line when these keys are pressed.

Once a command has been recalled, it can be executed by pressing "Enter", or it can be edited like any normal command. If the command is not edited before being executed, it will not be placed in the list again. If changes are made, it will be added to the end of the list.

If the "Enter" key is pressed when the command line is empty, the pointer is repositioned to the end of the list.

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Manipulation of variables

Manipulation of numbers

GENINTER provides some simple commands for integer number manipulation. All the numbers are converted to 32-bit signed integers, and all the operations are performed on 32-bit signed integers. A declaration of an unsigned type is not permitted. Therefore, SHORT variables cannot take on values greater than 0x7fff. Overflows on operations are **not** detected. You must therefore ensure that values passed to commands are within the ranges of the parameters. A *"Parameter out of range"* error will occur if the result of the operation does not fall within the limits permitted for this kind of parameter.

The commands for number manipulation are:

- **ABS <value>**
  Returns the absolute value of a unary expression.
- **CLEARNBR <identifier>**
  Erases the specified identifier from the number list and clears the memory associated with it. The identifier must already be defined by the *SETNBR* command in the number list. If no identifier is specified, *CLEARNBR* will erase all the identifiers in the number list and clear the memory associated with them.
- **DBLTOSTR <number> <nb_of_digits>**
  Converts a double into a string according to the number of significant digits required. Returns a pointer to the string of digits.
- **GETNBR <identifier>**
  Returns the value of the number identifier. If the number identifier is not in the number list (i.e., no value was previously assigned to this identifier by the *SETNBR* command), the value 0 is returned.
- **NBRTOSTR <value> <base>**
  Converts a unary expression value to a string according to the specified *base* parameter. The *base* parameter can be a unary expression with a value between 2 and 35.

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- **RAND**
  Returns a random value between 0 and 32767.
- **SETNBR <identifier> <value>**
  Assigns a numerical expression value to the specified identifier and adds this identifier to the number list.

  Example:

```
> setnbr n 3
> setnbr m -2
> setnbr n ( [ getnbr n ] + [ abs [getnbr m] ] )
> getnbr n
Return DWORD = 5
>
```

Manipulation of strings

The interpreter also supports commands for string manipulation. You can use the quotation marks (") to pass a whole string as a parameter. When a string is enclosed in quotation marks, it is considered as one parameter (even if there are spaces). Such strings are **not** converted to lowercase. Macro identifiers in a string are **not** expanded, but #1 ... #9 expressions are replaced by their corresponding values (see the *Command lists* section for more information on this type of parameter).

The commands for string manipulation are:

- **ADDSTR <string1> <string2>**
  Appends *string2* to *string1* and returns the resulting string (maximum resulting string length = 1024 characters).
- **CLEARSTR <identifier>**
  Erases the specified identifier from the string list and clears the memory associated with it. The identifier must already have been defined by the *SETSTR* command in the string list. If no identifier is specified, *CLEARSTR* will erase all the identifiers in the string list and clear the memory associated with them.

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- **CMPSTR <string1> <string2>**
  Compares *string1* and *string2* and returns -1 if *string1* is less than *string2*, 0 if *string1* is equal to *string2*, and 1 if *string1* is greater than *string2*.

- **GETSTR <identifier>**
  Returns the string value of the string identifier. If the string identifier is not in the string list (i.e., no value was previously assigned to this identifier by the *SETSTR* command), a NULL string is returned.

- **LEFTSTR <string> <n>**
  Returns the leftmost *n* characters of the string. The parameter *n* is a unary expression that must be between 0 and 1024.

- **LENSTR <string>**
  Returns the number of characters in the string.

- **MIDSTR <string> <n> <m>**
  Returns *m* characters from the string beginning at the *n*th character. If *n* is greater than the string length, then a NULL string is returned. The parameter *m* is a unary expression whose value must be between 0 and 1024. The parameter *n* is a unary expression whose value must be between 1 and 1024.

- **RIGHTSTR <string> <n>**
  Returns the rightmost *n* characters of the string. The parameter *n* is a unary expression that must be between 0 and 1024.

- **SETSTR <identifier> <string>**
  Assigns a string value to the specified identifier and adds this identifier to the string list.

- **STRTONBR <string>**
  Converts a string value into a number. The string must be in the following form:
  <" <dec_digit> [dec_digit...] "> *or*
  <" <0X *or* 0x> <hex_digit> [hex_digit...] ">
  If no conversion can be performed, this command returns 0; otherwise, a 32-bit signed integer is returned.

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- **STRTODBL <string>**
  Converts the specified string into a DOUBLE. Returns the DOUBLE value.

A string parameter can also be a command, but this command has to return a string. Here is an example of what you can do by using this type of parameter.

```
> setstr s0 "ABCD"
> setstr s1 "EFGH"
> setstr s01 [ addstr [getstr s0] [getstr s1] ]
> getstr s01
Return STRING = ABCDEFGH
>
```

Manipulation of arrays

GENINTER can also manipulate arrays. Four types of array commands are provided:

- Character array commands that allow you to access a linear array of unsigned bytes (between 0 and 255) at any specified index.
- Short array commands that allow you to access a linear array of signed words (16-bit signed integers) at any specified index.
- Long number array commands that allow you to access a linear array of signed double words (32-bit signed integers) at any specified index.
- Double array commands that allow you to access a linear array of double (64-bit floating-point numbers) at any specified index.

The commands for array manipulation are:

- **ALLOCARRAY <identifier> <size>**
  Allocates memory for a specified array identifier and adds this identifier to the array list. The *size* parameter is the number of bytes to allocate; it can be any unary expression equal to a value between 1 and 65535. If not enough memory is available, an error message is printed.

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- **CLEARARRAY <identifier>**
  Frees the memory associated with a specified identifier and erases the identifier from the array list. The identifier must have already been defined by the *SETARRAY* or *ALLOCARRAY* command in the array list. If no identifier is specified, *CLEARARRAY* erases all the identifiers in the array list and frees their associated memory.

- **GETARRAY <identifier>**
  Returns the address of the array identifier. If the array identifier is not in the array list (i.e., no address was previously assigned to this identifier by the *SETARRAY* or *ALLOCARRAY* command), a NULL address is returned.

- **GETCHRARRAY <identifier> <index>**
  Returns the value of a specified character array identifier at the selected index. The identifier must already be defined in the array list by the *SETARRAY* or *ALLOCARRAY* command. The *index* parameter can be any unary expression equal to a value between 0 and 65535. You must ensure that this value does not exceed the size of the specified array.

- **GETDBARRAY <identifier> <index>**
  Returns the value (64 bits) of a specified number array identifier at the selected index. The identifier must already be defined in the array list by the *SETARRAY* or *ALLOCARRAY* command. The *index* parameter can be any unary expression equal to a value between 0 and 65535. You must ensure that this value does not exceed the size of the specified array.

- **GETNBRARRAY <identifier> <index>**
  Returns the value (32-bit signed integer) of a specified number array identifier at the selected index. The identifier must already be defined in the array list by the *SETARRAY* or *ALLOCARRAY* command. The *index* parameter can be any unary expression equal to a value between 0 and 65535. You must ensure that this value does not exceed the size of the specified array.

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- **GETSHORTARRAY <identifier> <index>**
  Returns the value (16-bit signed integer) of a specified number array identifier at the selected index. The identifier must already be defined in the array list by the *SETARRAY* or *ALLOCARRAY* command. The *index* parameter can be any unary expression equal to a value between 0 and 65535. You must ensure that this value does not exceed the size of the specified array.
- **SETARRAY <identifier> <address>**
  Assigns an address to the specified identifier and adds this identifier to the array list. This command can give direct access to any memory space and must therefore be used with some caution.
- **SETCHRARRAY <identifier> <index> <value>**
  Assigns a unary expression value (between 0 and 255) to the specified character array identifier at the selected index. The identifier must already be defined in the array list by the *SETARRAY* or *ALLOCARRAY* command. The *index* parameter can be any unary expression equal to a value between 0 and 65535. You must ensure that this value does not exceed the size of the specified array.
- **SETDBARRAY <identifier> <index> <value>**
  Assigns a unary expression value (64 bits) to the specified number array identifier at the selected index. The identifier must already be defined in the array list by the *SETARRAY* or *ALLOCARRAY* command. The *index* parameter can be any unary expression equal to a value between 0 and 65535. You must ensure that this value does not exceed the size of the specified array.
- **SETNBRARRAY <identifier> <index> <value>**
  Assigns a unary expression value (32-bit signed integer) to the specified number array identifier at the selected index. The identifier must already be defined in the array list by the *SETARRAY* or *ALLOCARRAY* command. The *index* parameter can be any unary expression equal to a value between 0 and 65535. You must ensure that this value does not exceed the size of the specified array.

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- **SETSHORTARRAY <identifier> <index> <value>**
  Assigns a unary expression value (16-bit signed integer) to the specified number array identifier at the selected index. The identifier must already be defined in the array list by the *SETARRAY* or *ALLOCARRAY* command. The *index* parameter can be any unary expression equal to a value between 0 and 65535. You must ensure that this value does not exceed the size of the specified array.

  Example:

```
> allocarray table 4
> setchrarray table 0 30
> setchrarray table 1 2
> setchrarray table 2 90
> setchrarray table 3 16
> getchrarray table 1
Return UBYTE = 2
> cleararray table ;
```

Macros

A macro is defined as a word that can replace a typed string. There is no limitation on the content of the string, aside from the fact that all the characters must be printable. They can be found anywhere on the command line, and can replace a command, or a series of parameters, or both combined in the same macro. The GENINTER macro control commands are:

- **MACRO [identifier [definition]]**
  Assigns a definition to the specified identifier, or redefines the macro identifier if it already exists. If the definition part is omitted, the macro identifier, its definition, and its current expansion are printed. If both the identifier and the definition are omitted, the complete list of currently defined macros, their respective definitions, and expansions are printed.
- **DELMACRO [identifier]**
  Deletes the macro identifier from the macro list, or, if no identifier is specified, deletes the whole macro list.

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- **SAVEMACRO <filename>**
  Saves the entire macro list (names and definitions), as currently defined in the specified file. Unless only one macro is currently defined, macros cannot be saved individually.
- **LOADMACRO <filename> [parameter...]**
  Retrieves a macro list (identifiers and definitions) from the specified file. If one or more of the macros retrieved were already defined, the former definitions are deleted and those retrieved become the new definition. For more information on files, see the *File handling* section.

Macros cannot be defined circularly; this type of definition will be rejected when you try to define the macro (according to the other macros already defined).

A macro name can be used in another macro definition.

The macro name cannot be a command name, a subset of a command name, or a command list name. The two reserved words *MACRO* and *DELMACRO* cannot be used in a macro name or in a macro definition.

Refer to the *Interpreter Syntax* section for information about identifier, filename, and definition syntax.

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Command lists

A command list is a list of commands that can be executed sequentially. When creating command lists, GENINTER stores the command in memory. GENINTER also has commands for storing and retrieving command lists on disk. You can even execute command lists directly from disk. Whether in memory or on disk, you can specify parameters when invoking command lists.

When you write a command list, it can be useful to include comments. You can do so anywhere, by typing ';' followed by your comment. Comments can contain any character, since anything between the ';' and the next line will be ignored by the interpreter.

A command list can call another command list, or can call itself recursively. The parameters not defined when invoking the command list are treated as empty strings.

You can interrupt the execution of a command list at any time by pressing "Ctrl+Break".

The following lists the GENINTER command list control commands.

- **ADDFUNCTION <name> <sync> <opcode>**
  [type1] [type2] ... [typeN]
  ["["returntype1"]"] ["["returntype2"]"]
  ... [["returntypeN"]"]

  Adds user-defined C-binding functions to the interpreter's list of commands. The *name* parameter is the actual user-defined C-binding function name, in quotes. The *sync* parameter can be either _IM_WAIT or _IM_NO_WAIT. The *opcode* parameter is a user-defined operation code (previously defined using the Developer's Toolkit). The operation code starts at 10000 for the first user-defined C-binding function, 10001 for the second, etc. When a parameter type is a pointer, the '*' character must be concatenated, without a space, to the end of the type keyword. Return parameter types are defined by enclosing the type in square brackets.

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Note the following:

- Always place the thread ID as the first argument for your C-binding functions. The thread ID must always be a variable of type "long", so "long" will always be the first parameter for user-defined C-binding functions.
- Choose from "char", "short", "long", or "double" for *type1* through *typeN* and *returntype1* through *returntypeN*.
- All returned parameter types must be pointers.

- **DELCL [identifier]**
  Removes the identified command list from memory, or all the command lists if no identifier is specified.
- **EDITCL <identifier>**
  Edits a command list. If the command list identifier does not already exist, an empty command list is created and can be edited. Refer to the *Editing command lists* section for more information.
- **EXECCL <filename> [parameters...]**
  Executes a command list in the specified file directly from disk, without loading it into memory. The parameters will be accessible in the same way as the previous command. For more information on files, see the *File handling* section.
- **IDENTIFIER [parameter...]**
  Executes a command list already in memory. Type in the full identifier of the desired command list. The parameters will be accessible from the command list using the symbols #1,#2, ... and #9, the number corresponding to the position of the desired parameter on the line (similar to batch-file handling of parameters). For more information on files, see the *File handling* section.
- **LISTCL [identifier]**
  Lists on-screen the contents of the identified command list defined in memory. If the identifier is omitted, all the identifiers of the command lists currently defined in memory are listed.

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- **LOADCL <identifier> <filename>**
  Retrieves a command list from the specified file on disk, and assigns it the specified identifier.
- **ONBREAK [identifier]**
  Sets up a command list identifier that will execute when "Ctrl+Break" is pressed. If the identifier is omitted, the prompt is directly returned without executing a command list.
- **RETURN**
  Terminates the execution of a command list in which it appears and returns control to the calling command list (or interpreter shell when the command list is directly called by the shell).
- **SAVECL <identifier> <filename>**
  Saves the identified command list in the specified file on disk. A warning mechanism protects the user from overwriting a file that already exists.

Editing command lists

Command lists can be edited and saved with any text editor. GENINTER provides its own command list editor, which can be accessed with the *EDITCL* command. This command allows you to edit command lists of up to 16K on a full-screen editor.

Key functionality

The functionality of the keys for the command list editor is the same as that for the line editor (see the *Editing* section), except for the following keys:

Up	Moves the cursor up one line (scrolls the whole screen down if already at the top of the screen).
Down	Moves the cursor down one line (scrolls the whole screen up if already at the bottom of the screen).
Page Up	If the cursor is already at the top of the screen, pressing "Page Up" causes the screen to scroll down (the first line on the screen becomes the last one). If the cursor is not at the top of the screen, pressing "Page Up" moves the cursor to the first line on the screen.

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Page Down	If the cursor is already at the bottom of the screen, pressing "Page Down" causes the screen to scroll up (the last line on the screen becomes the first one). If the cursor is not at the top of the screen, pressing "Page Down" moves the cursor to the last line on the screen.
Ctrl+PgUp	Moves the cursor to the start of the file.
Ctrl+PgDn	Moves the cursor to the end of the file.
Esc	Returns to the editor when F1 has been pressed; see below.
Enter	Inserts a new line character and moves the cursor to the first character on the next line.
Ctrl+Break	No effect.

GENINTER also has a set of special editing function keys:

F1	Quits the editor and returns to the interpreter. GENINTER asks if you want to save the command list before leaving the editor.
F4	Deletes the line on which the cursor is positioned, and scrolls everything below one line up.
F5	Marks a block for copy or cut.
F6	Copies the highlighted block to an internal buffer. Deletes the previous contents of the internal buffer.
F7	Copies the highlighted block to an internal buffer and deletes the block from the editing buffer. Deletes the previous contents of the internal buffer.
F8	Retrieves the contents of the internal buffer and inserts it into the editing buffer at the current cursor position. A message is displayed if there is not enough memory left in the editing buffer to insert the block.

If the identifier specified when invoking the command list does not exist, the editor creates a new command list using the identifier filename.

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Advanced features

Conditional operation

A conditional operator makes decisions with regards to program flow based on the result of a unary expression.

Branch programming introduces a new parameter selection. As well as using a unary expression, string, or identifier, you can use a command block:

parameter = <unary_exp *or* string *or* identifier *or* block>
where block = <command *or* { command... }>

You must have only one command per line (a carriage return is a command separator). The interpreter allows the following conditional operators.

- **IF <condition> <block>**
  Executes the following command block, if the condition is true (not 0). The condition can be any unary expression where the comparison is not made to a DOUBLE constant or DOUBLE variable.
- **ELSE <block>**
  Executes the following command block, if the condition of the last *IF* command (at the same block level) is false (0).

Example:

```
> setnbr n 3
> if ( [ getnbr n ] == 4 )
>   {
>   echo "n == 4"
>   }
> else
>   {
>   if ( [ getnbr n ] < 4 )
>     echo "n < 4"
>   else
>     echo "n > 4"
>   }
n < 4
>
```

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Loop

You can use loops to execute a certain command a specified number of times or until a particular event is reached.

You can interrupt the execution of a loop at any time by pressing "Ctrl+Break".

The interpreter allows three kinds of loops:

- **DO <block> <condition>**
  The command block of the *DO* loop is executed one or more times until the condition becomes false (0). The condition can be any unary expression. Execution proceeds as follows:

  1. The command block is executed.
  2. The condition is evaluated. If the condition is false, the *DO* loop terminates else the process is repeated, beginning with step 1.

- **WHILE <condition> <block>**
  The command block of the *WHILE* loop is executed zero or more times until the condition becomes false (0). The condition can be any unary expression, where the comparison is not made to a DOUBLE constant or DOUBLE variable. Execution proceeds as follows:

  1. The condition is evaluated.
  2. If the condition is false, the *WHILE* loop terminates.
  3. The command block is executed and the process is repeated, beginning with step 1.

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- **FOR [identifier] <start> <end> <step> <block>**
  The command block of the *FOR* loop is executed zero or more times until the condition becomes false (0). The *start*, *end*, and *step* parameter can be any unary expression between -32768 and 32767. Execution proceeds as follows:

  1. The *start*, *end*, and *step* parameters are evaluated. An internal counter is set to the *start* value. The *end* and the *step* parameters are kept in memory and they are not evaluated during the next process.
  2. If the *step* value is positive:
     a. If the counter is greater than or equal to the *end* value, then the *FOR* loop terminates.
     b. The command block is executed.
     c. The counter is incremented by the *step* value and the process is repeated, beginning at 2a.
  3. If the *step* value is negative:
     a. The counter is incremented by the negative *step* value.
     b. If the counter is less or equal to the *end* value then the *FOR* loop terminates.
     c. The command block is executed and the process is repeated, beginning at 2a.
  4. If the *step* value is equal to 0, the command block is executed indefinitely.

  A counter identifier can also be used as an internal reference for counter value access in the following command block. If the identifier is omitted, the counter identifier 'i' is assumed by default.

  To access the counter value in a unary expression, type '_' followed by the counter identifier.

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Example:

```
> for 0 6 2 ; Use the default counter i
>    {
>     echoln "i =  "
>     echo [nbrtostr _i 10]
>    }
> i = 0
> i = 2
> i = 4
> for x 0 2 1  ;Use counter identifier x
>    {
>     echoln "x =  "
>     echo [nbrtostr _x 10]  ;Note the '_' in front of the x
>     for y 2 0 -1  ; Use counter identifier y
>        {
>         echoln "y =  "
>         echo [nbrtostr _y 10]  ;Note the '_' in front of the y
>        }
>    }
> x = 0
> y = 1
> y = 0
> x = 1
> y = 1
> y = 0
```

Timer

It is sometimes useful to affect delays in programming or to find out the execution time of some commands. Here are commands for doing so:

- **DELAY <milliseconds>**
  Waits a specified number of milliseconds before executing the next command. Note that this command should not be used in conjunction with the *GETTIMER* and the *SETTIMER* commands.
- **GETTIMER**
  Prints on the screen the time elapsed (in milliseconds) since *SETTIMER* was last called.
- **SETTIMER**
  Resets the interpreter's internal timer.

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I/O - keyboard and Host display

To make more interactive command lists, the interpreter provides these simple I/O commands:

- **CLEARHOST**
  Clears the host screen to black.
- **ECHO [string]**
  Prints the specified string on the host screen and sets the printing position to the beginning of the next line. If no string is specified, nothing is printed and a line is skipped.
- **ECHOLN [string]**
  Prints the specified string on the host screen and leaves the printing position on the same line. If no string is specified, nothing is printed and the printing position stays the same.
- **SETECHOPOS <x> <y>**
  Changes the current printing position to column *x* (1 to 80) and line *y* (1 to 25).
- **GETECHOPOS**
  Returns the current printing position's x and y coordinate.
- **INSTR <identifier>**
  Receives a string from the keyboard until the "Enter" key is pressed and assigns this string value to the specified identifier.
- **INKEY**
  Waits for a keystroke and returns a key code.
- **KEYHIT**
  Returns a nonzero value if a key has been pressed; otherwise, it returns 0.
- **PAUSE [string]**
  Prints, on the screen, the specified string (or a standard message if no string is specified) and waits for a keystroke before executing the next command.

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File handling

All files saved and retrieved by the interpreter are handled in the same way. They are always saved in command syntax, in plain ASCII text (in the same way a command is normally typed in using the keyboard). When you use the *SAVEMACRO* command, all the macros are saved in a file. When you use the *SAVECL* command, an entire command list already in memory is saved.

Three commands can be used to retrieve a file: *EXECCL*, *LOADMACRO* or *LOADCL*.

- *EXECCL* only executes commands residing on disk, not commands entered on the keyboard.
- *LOADMACRO* is similar to *EXECCL* and is used in conjunction with *SAVEMACRO*.
- *LOADCL* retrieves the list of commands and places it in memory without executing it. By assigning a symbolic name for the command list, you can execute the command list at any time by entering its symbolic name.

When you invoke the interpreter, the first thing it does after initialization is call *EXECCL*, either with the filename passed on the command line as a parameter, or with the *geninter.ini* file. If *geninter.ini* is not found in the current directory, the *EXECCL* command is not executed.

Since all the files are saved in ASCII format, they can be created and/or edited using any text editor that accepts and generates ASCII files.

The following lists the GENINTER file handling commands.

- **FCLOSE <fileHandle>**
  Closes the specified file. Returns 0 if successful; returns a non-zero integer if an error was detected.
- **FGETC <fileHandle>**
  Gets the next character in the specified file and returns that character.

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- **FGETS <buffer> <nb_of_char> <fileHandle>**
  Reads a string of characters from the specified file and stores it in the specified buffer. It reads characters, starting from the current file position, until one of the following conditions is encountered: an EOF, a newline character, or a character count of one less than the specified number of characters. If a newline character is encountered, it is included in the string. A null character is placed immediately after the last character read into the array. Returns a pointer to the buffer if successful; returns NULL if an error was detected.

- **FOPEN <fileHandle> <attributes>**
  Opens the specified file for data transactions of the type specified by the *attributes* parameter. The most common attributes are: "r" (read), "w" (write), and "a" (append). Any combination of attributes can be concatenated in the same attribute string. Returns the fileHandle that can be used to reference the file in future accesses.

- **FPUTC <character> <fileHandle>**
  Puts the specified character in the specified file. Returns the character written if successful; returns EOF if a write error was detected.

- **FPUTS <string> <fileHandle>**
  Puts the specified string in the specified file. Returns a non-negative value if successful; returns EOF if an error was detected.

- **FSEEK <fileHandle> <offset> <where_indicator>**
  Changes the read/write position of the specified file. The new position is the offset from the position specified by the *where_indicator* parameter. Set *where_indicator* to SEEK_SET to offset from the beginning of the file, SEEK_CUR to offset from the current postion, SEEK_END to offset from the end of the file.

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- **FTELL <fileHandle>**
  Returns the curent read/write position of the specified file. Returns -1 if an error was detected.
- **REWIND <fileHandle>**
  Sets the read/write position of the specified file to the beginning of the file.

Miscellaneous commands

This section contains commands that do not fit into previously described categories.

- **CLEARALL**
  This command re-initializes the three types of lists (array list, string list, and number list).
- **GETSTRPTR <name>**
  Returns a pointer to the specified string. This string is usually hardcoded into a variable such as a #define. Either an explicit string or a pointer-to-a-string must be passed to functions that require string arguments. Therefore, this function is useful when a filename is hardcoded into a variable used repeatedly in a command list.
- **HELPPATH <"path">**
  Loads a help path into the interpreter. This path is the location of all the help files a user might need. If used in *geninter.ini* or any command list, it overrrides the INTER_HELP environment variable.
- **QUIT**
  Quits the program and returns to DOS. You will not be prompted to save command lists or macros.
- **RADIX <newRadix>**
  Changes the base of the displayed numbers. The *newRadix* parameter can be: BIN, OCT, DEC, or HEX. The interpreter default is base ten (DEC).
- **RESERVED**
  Lists all the reserved words (internal commands and library function names) and currently defined names (macros and command lists).

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- **SILENCE <1 | 0>**
  Turns the silence mode on (1) or off (0). When the silence mode is on, the return values of a command are not automatically printed on the screen. When the silence mode is on, the interpreter prompt changes to S>.

- **TRACE <1 | 0>**
  Turns the trace mode on (1) or off (0). The trace mode affects only command lists and loop executions. When the trace mode is on, the command line is executed and printed on the screen. You must press a key before executing the next command. When trace mode is on, the interpreter prompt changes to T>.

- **VERBOSE <1 | 0>**
  Turns the verbose mode on (1) or off (0). The verbose mode affects only command lists and loop executions. When verbose mode is on, the commands are printed on the screen after being executed. When verbose mode is on, the interpreter prompt changes to V>.

  When both Verbose and Trace modes are on, the evaluated command line is also printed after being executed. This line contains the final form of the parameter value and is very useful for command list debugging.

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Os shell

The *SYSTEM* command makes it possible for you to access DOS from the interpreter without having to exit it (whether you are in the DOS version or the Windows version of the interpreter). To do so, enter the following at the prompt:

```
system [identifier [arguments...]]
```

A command identifier can be any command that can normally be entered at the DOS prompt, that is, commands internal to DOS (TIME, DIR, etc.) and valid program names (with *.exe*, *.com*, or *.bat* extensions), including their arguments.

If no command identifier is specified, the interpreter stays in memory but gives temporary control to DOS, reflected by the DOS prompt, and can do just about anything you can normally do at the DOS level. You can return to the interpreter by typing "EXIT" at the DOS prompt.

If a command identifier is specified, it is executed and as soon as the program is over, the interpreter regains control.

Whether or not a command identifier is given, you will be able to use the SET, PATH, and PROMPT commands, but the changes will not be saved when you return to the interpreter. In other words, the SET, PATH, and PROMPT commands are read-only.

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Error messages

- ***"Ambiguous command"***

  Not enough characters were supplied to differentiate the command from another.

- ***"Cannot modify a command list that is currently being executed"***

  A command list cannot be modified if it is executing. The command is simply ignored. Note that you can modify a command list when running another command list.

- ***"Cannot open the file properly"***

  The interpreter was not able to open the file properly, either because the file is corrupted or because too many files are already open.

- ***"Cannot save the file properly"***

  An error was detected during the saving of the file, and saving might not have been carried out properly. The file might be corrupted or unusable.

- ***"Command list name already exists"***

  The name passed as a parameter is already defined as a command list.

- ***"Command list name does not exist"***

  The command list name passed as a parameter does not exist.

- ***"Command list too big for the editor"***

  The command list exceeded 16K in size, and thus cannot be edited inside of the interpreter.

- ***"Command name already exists"***

  The name passed as a parameter already exists as a command name (a command internal to the interpreter, a library command or a user-defined command) or as the first distinctive characters of a command name.

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- ***"Division by 0 attempted"***

  A division (or modulo) by 0 was attempted. The function was not executed.

- ***"End of command list encountered unexpectedly"***

  The end of the command list was encountered unexpectedly. This error may indicate a missing closing brace ("}") at the end of your command list.

- ***"File does not exist"***

  The filename passed as a parameter cannot be found in the specified path.

- ***"Help error: Unrecognized command"***

  The command passed as a parameter is not a command internal to the interpreter, a command from the library, a user-defined command, or a command list name.

- ***"Illegal identifier in macro definition"***

  The *MACRO* and/or *DELMACRO* commands were found in the macro definition. These two command words (and their first distinctive characters) cannot be part of a macro definition.

- ***"Illegal name for an identifier"***

  The name specified as an identifier is not permitted. The first character of an identifier cannot start with a digit.

- ***"Invalid number of parameters"***

  The command was recognized, but the number of parameters for that specific command was incorrect.

- ***"Last command not recorded properly"***

  The last command could not be properly saved to the record file.

- ***"Macro name already exists"***

  The name passed as a parameter is already defined as a macro name.

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- ***"Macro name does not exist"***

  The macro name passed as a parameter does not exist.

- ***"Maximum length of string reached"***

  The maximum of 1024 characters for a string has been reached.

- ***"Not enough memory to add a macro definition"***

  There is not enough memory on the heap to dynamically allocate space for a new macro.

- ***"Not enough memory to create a command list"***

  There is not enough memory on the heap to dynamically create a new command list.

- ***"Not enough memory to edit a command list"***

  There is not enough memory to load the editor, which needs 32K of memory to execute (16K for the editing buffer and 16K for the paste buffer).

- ***"Not enough memory to execute another command list"***

  There is not enough memory left on the heap to allocate memory to execute another command list.

- ***"Not enough memory to execute the command"***

  There is not enough memory to execute the command; or the available memory has been corrupted; or an invalid block exists, indicating that the process making the call was not allocated properly.

- ***"Not enough memory to perform the initialization"***

  There is enough memory to load the program, but not enough to enable it to perform all the dynamic initializations.

- ***"Not enough space left in editing buffer"***

  There is not enough space left in the editing buffer to insert a new character, or to paste the contents of the paste buffer.

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- ***"Out of memory: command list creation halted"***

  There is not enough memory left to add another line to the command list. The creation of the command list was halted and the user was returned to the interpreter prompt.

- ***"Parameter out of range"***

  At least one of the parameters passed is out of range (greater than the maximum value or less than the minimum value) for that parameter type.

- ***"Parameter syntax error"***

  There is an error in the syntax of one or more parameters. Check for missing ")" or "]" in your parameter list and make sure all operator and constant values have the correct syntax.

- ***"Parameter type mismatch"***

  An attempt to pass a string parameter as a numerical value, or some other type of mismatch, was detected.

- ***"Recording is already on"***

  The recording had already been turned on. The command was ignored.

- ***"Return index out of range"***

  The specified return index is greater than the number of the returned value.

- ***"System command interpreter cannot be found"***

  The system shell cannot be found. The COMSPEC environment variable should be set to reflect the path where the file can be found.

- ***"System command interpreter is not executable"***

  The system shell file has an invalid format and is not executable.

- ***"The argument list for the command is too big"***

  The argument list that can be passed to DOS is limited to 127 characters.

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- ***"Too many subdefinitions. Macro not created"***

  The definition of the macro, when checked against the other macros currently defined, causes an endless loop or too many subdefinitions occur. The macro was not created, and the former definition (if there was any) will be lost.

- ***"Unrecognized command"***

  The command is not a command internal to the interpreter, a command from the library, a user-defined command, or a command list name.

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Interpreter syntax

The following presents the GENINTER syntax. Note that a single character enclosed in " " (for example, "[") means you must include the character.

- **char** = any single representable character
- **bin_digit** = <0 *or* 1>
- **dec_digit** = <0 *to* 9>
- **hex_digit** = <0 *to* 9 *and* A *to* F>
- **letter** = <A *to* Z *and* a *to* z *and* _>
- **int_const** = <<dec_digit> [dec_digit (long)] *or*
  <0D *or* 0d> <dec_digit> [dec_digit (double)] *or*
  <0B *or* 0b> <bin_digit> [bin_digit...] *or*
  <0X *or* 0x> <hex_digit> [hex_digit...]>>
- **char_const** = <' char '>
- **const** = <int_const *or* char_const>
- **string** = <"[char...]" *or* "[command]">
- **identifier** = <letter> [<letter *or* dec_digit>...]
- **unary_op** = <! *or* ~ *or* + *or* ->
- **binary_op** = <* *or* / *or* % *or* + *or* - *or* << *or* >> *or*
  == *or* < *or* > *or* != *or* <= *or* >= *or*
  & *or* | *or* ^ *or* && *or* | |>
- **term** = <const *or* "(" binary_exp ")" *or* "[" command "]">
- **unary_exp** = [unary_op] <term>
- **binary_exp** = <unary_exp> [<binary_op unary_exp>...]
- **block** = <command *or* { command... }>
  Note: You must have only one command per line (CR is the command separator).

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- **parameter** = <unary_exp *or* string *or* identifier *or* block>
- **command** = [int_const] <identifier> [parameter...]
- **filename** = string
  Example: "A:\GENINTER.EXE"
- **definition** = [char...]
- **comment** = <; [char...]>

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Chapter 5: MGA Power Desk

This chapter provides information about the MGA Power Desk.

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Overview

The optional display section of Matrox Genesis is powered by the Matrox MGA Millennium 2064W graphics accelerator. As a result, the **MGA Power Desk** works with Matrox Genesis. The **MGA Power Desk** is installed when you install the MGA WIN NT display driver. Installation of the MGA WIN NT display driver was discussed in Chapter 3.

Driver version

If you have a different version of the **MGA Power Desk**, some information might be different; for the most up-to-date information, refer to the on-line help of the **MGA Power Desk**.

The MGA PowerDesk group

The **MGA Power Desk** group includes the following programs:

- **Desktop Navigator**: Provides zoom and CenterWINDOW options.
- **QuickDesk**: Gives you direct access to some of the major features of the **MGA Power Desk Control Panel**. **QuickDesk** can be set to always appear on top and within the visible area of your Windows display.
- **PowerDesk Uninstall**: Removes or disables all or parts of the MGA Windows software.

The presence of the **MGA Control Panel** icon at the bottom of your screen indicates that the driver is active. This icon can be used to launch the **MGA Control Panel**. It also indicates the current resolution, display mode, and desktop size.

Display Properties

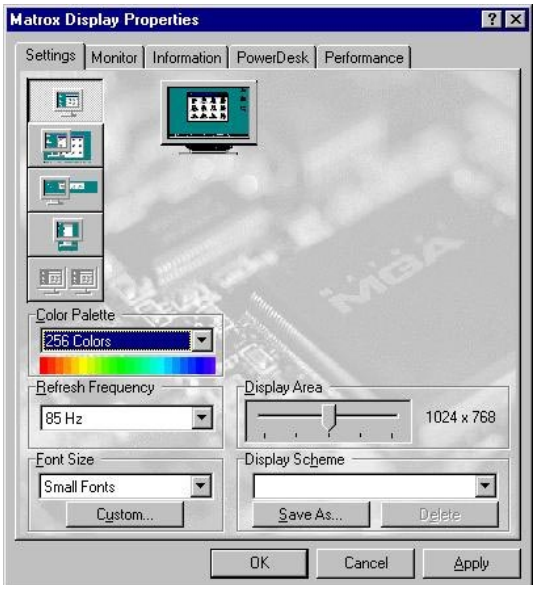
You can open the **Display Properties** dialog box by selecting **Settings** from the **Start** menu and then clicking on **Control Panel**. Choose the **Display** icon. Another way to bring up the **Display Properties** dialog box is to press the right mouse button on the desktop and then select **Properties.** Note that this method is faster than going through the **Control Panel**.

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The **Display Properties** dialog box includes the following tabs:

MGA Settings

This property sheet displays the current display resolution, pixel depth, and refresh rate; and information about the graphics card.



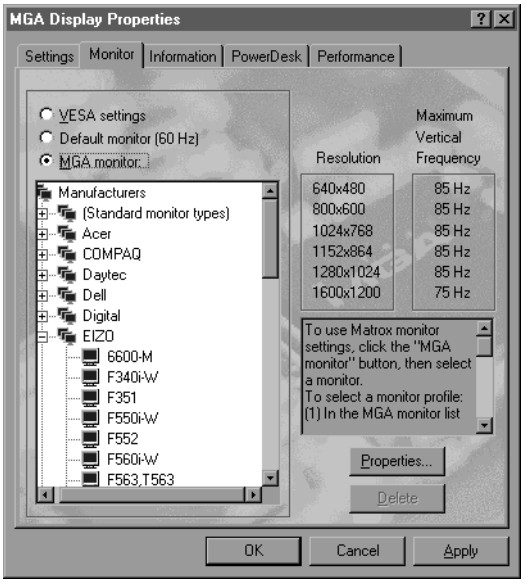
Click the **Advanced** button to view the following options:

- **Information**. This tab displays information about the MGA 2064W accelerator, such as the amount of on-board memory.
- **Performance**. This tab allows you to toggle options such as 3D double buffering and device bitmap caching. Note that:
  - 3D hardware acceleration is available at pixel depths of 15, 16, or 32 bits per pixel. Since Genesis only supports 8 bits per pixel, 3D acceleration is not available.
  - When enabled, bitmaps are stored in Matrox Genesis's overlay (VGA) frame buffer instead of in Host memory.
- **MGA PowerDesk**. This tab allows you to assign hotkeys. A hotkey is a combination of keystrokes that allow you to quickly access various desktop features. For example, the CenterWINDOW hotkey centers the active display window.

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MGA Monitor

This property sheet allows you to select and test your monitor. Select the monitor from the list and then click on **Apply**. You must restart Windows for the change to take effect.



Multiple display boards

If you have more than one display board, a list of all boards appears in the **MGA Monitor** sheet. Select the board number for the monitor you wish to configure and then select a monitor.

Plug-and-play monitors

Note that, even though Plug-and-Play (VESA DDC) monitors are supported by the Matrox MGA Millennium, this feature is not available with the current implementation of Matrox Genesis.

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Desktop features

The **MGA Power Desk** includes several desktop features:

- CenterWINDOW
- CenterPOPUP
- MaxVIEW
- PanEND
- PanHOME
- PanLOCK
- Zoom (PixelTOUCH)
- Acceleration features

You can access these features from the **MGA PowerDesk** tab by pressing the **Advanced** button under **MGA Settings**.

CenterWINDOW

CenterWINDOW pans and scrolls the desktop to center the active display window on the screen. This is useful when you have opened multiple applications and they are not all visible at once on your desktop. With CenterWINDOW, you can center the display around any one of them.

To center the display of the active application, switch to the desired application using Task Manager (Ctrl+Esc) and then use the CenterWINDOW hotkey. The mouse pointer is positioned in the center of the window.

Note that, in a multiple-screen configuration, repeatedly pressing the CenterWINDOW hotkey will cause the currently active window to be centered on one screen, then on the next, then on the other, etc.

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CenterPOPUP

CenterPOPUP ensures that every pop-up error message or warning dialog box appears centered on the screen. This is very useful when you are using a virtual or zoomed desktop.

This feature works only on pop-up windows, which means that other types of windows (such as application windows, floating toolbars, etc.) are not affected. CenterPOPUP differs from CenterWINDOW in one essential way: CenterPOPUP moves the pop-up window into the desktop area that is displayed on the screen, whereas CenterWINDOW pans and scrolls the desktop to center the active application window on the screen.

MaxVIEW

MaxVIEW limits the size of the window so that it does not extend outside your immediate on-screen work area (you can still scroll to any off-screen area on your desktop). When enabled, MaxVIEW applies to any Windows application that is maximized.

❖ Some programs, such as MS Word for Windows, might extend vertically beyond the visible window, even when MaxVIEW is enabled.

PanEND

PanEND moves your display to the bottom of a vertical virtual desktop or to the right of a horizontal virtual desktop. This feature is for virtual desktop only.

PanHOME

PanHOME moves your display to the top of a vertical virtual desktop or to the left of a horizontal virtual desktop. This feature is for virtual desktop only.

PanLOCK

PanLOCK enables or disables panning. When enabled, you can move your mouse pointer to the edge of the view area to pan in that direction. This feature can be used if you have a virtual or zoomed desktop.

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Zoom (PixelTOUCH)

Zoom uses the MGA hardware to instantly zoom your desktop by a factor of 2 or 4. When zooming, you are working with a pseudo-virtual desktop. Moving the cursor to the different edges of the screen will pan your display to different portions of the Windows desktop. You can change the zoom factor by:

- Using the **Zoom** buttons in the **MGA Control Panel** dialog box; or
- Using the PixelTOUCH hotkey. The PixelTOUCH hotkey, when enabled, toggles in a circular order through the three zoom factors (x1, x2, x4, x1, ...); or
- Using **QuickDesk**. To zoom in or out of the current view, simply click on the '+' or '-' button.

Note the following:

- The x4 zoom is not available at resolutions of 800 x 600 and lower.
- The display pans 32, 64, and 128 pixels at a time at zoom factors of x1, x2, and x4, respectively.
- The PixelTOUCH hotkey does not work in a DOS shell.

Acceleration features

The **Device Bitmaps** option, when enabled, stores bitmaps in Matrox Genesis's overlay (VGA) frame buffer instead of in Host memory.

❖ The **Device Bitmaps** option has been proven to improve performance when used with some applications. However, with certain applications, the display is redrawn incorrectly if this option is enabled. If this happens, disable the option when using that application.

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MGA Uninstall Program

The **MGA Uninstall Program** allows you to disable or remove all or part of the MGA Windows software. When you use this program, all the files you choose to uninstall are **deleted** from your hard disk, and all entries pertaining to these files are removed from your Windows *.ini* files.

To remove software, click on **MGA PowerDesk Uninstall** from the **MGA Power Desk** group. In the **MGA Uninstall Program** dialog box, choose to uninstall the **MGA Power Desk** or both the **MGA Power Desk** and drivers.

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Chapter 6: Matrox Genesis Hardware Reference

This chapter explains the architecture of the Matrox Genesis hardware, as well as its features and modes.

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Genesis hardware reference

This chapter provides information on the architecture of the Genesis hardware. Four separate parts are covered: the Genesis hardware related to the processing of images, the transfer of data, the options available for the acquisition of images, and those available for their display. The optional Genesis grab module and display section are described in Chapter 7 and Chapter 8, respectively.

Processing

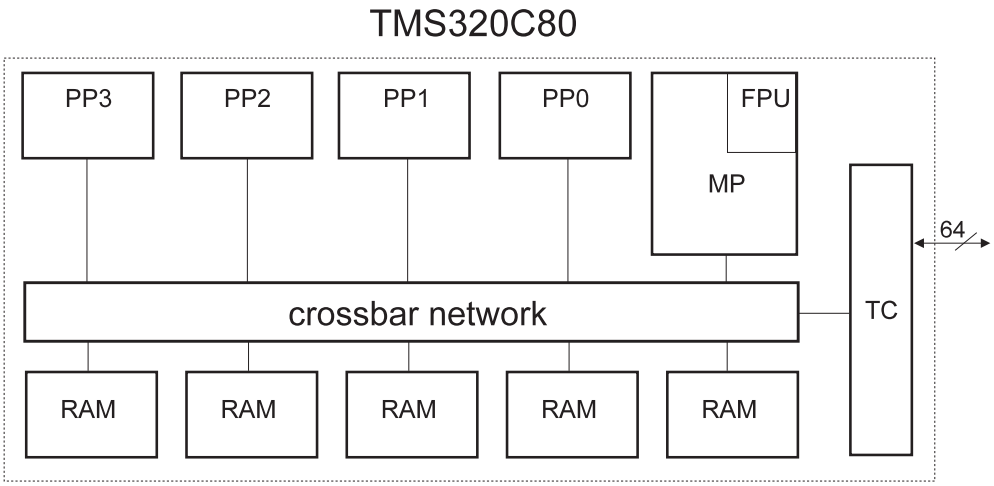
Processing is the primary function of Genesis. To provide high-speed processing capabilities, the board incorporates a powerful multi-processor DSP, an optional neighborhood operation accelerator (NOA), and on-board memory. Since processing is independent of the grab, you can perform flexible, real-time operations. For example, you can double-buffer by alternating the grab between two destination buffers.

❖ This section does not apply to the Genesis-LC, since the Genesis-LC does not have a processing section.

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TMS320C80

Texas Instrument's TMS320C80 multi-processor DSP ('C80) is used on Genesis. The following is a simplified block diagram:



PP0-3 : Parallel processors 0-3 (advanced DSP, 32-bit integer units)
MP : Master processor (32-bit RISC processor with an IEEE-754 FPU)
FPU : Floating-point unit
TC : Transfer controller (transfers data between external and internal memory)
RAM : on-chip memory
crossbar network: high-speed bus switching network between processors and RAM

The 'C80 running at 50-MHz features a 32-bit RISC master processor with an integrated floating point unit (FPU) capable of 100 MFLOPS, four 32-bit parallel processors (PPs) with combined power of up to 2 billion RISC-like operations per second, on-chip memory, and a transfer controller (TC) for high performance external I/O (400 Mbytes/sec off-chip peak transfer rate). For optimal internal connectivity, it uses a crossbar network for on-chip data transfer (2.4 GBytes/sec sustainable transfer rate).

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NOA

Operating at 50 MHz, the optional NOA accelerates neighborhood operations (by a factor of up to 20, over the 'C80 alone). These operations include convolutions, normalized grayscale correlation, binary and grayscale morphology, and pattern matching. The NOA also supports lossless JPEG encoding and decoding.

SDRAM

Genesis uses 8, 16, 32, or 64 MBytes of SDRAM as on-board processing memory. Since this memory is accessed linearly, there are no unnecessary restrictions on image size and pixel depth. Part of the SDRAM is used to store the 'C80 program code.

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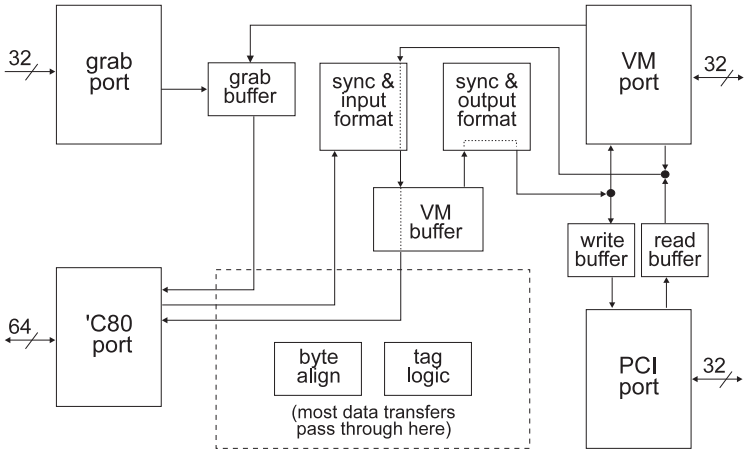
Data transfer

Genesis features very efficient data transfer between on-board components, different boards, and the Host.

The Video Interface ASIC

The VIA is a high-performance chip that links on-board acquisition, display, processing, and external resources. It allows the transfer of data between various interfaces: the grab port, the VMChannel, the SDRAM or the WRAM, and a PCI bus (as a master or a slave).

Genesis can have two VIAs: the primary VIA of the processing section and the display VIA of the optional display section. This chapter describes the functioning of the primary VIA, while the display VIA is described in Chapter 8. The following is a block diagram of the primary VIA:



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Simultaneous data streams

The VIA manages up to two simultaneous data streams:

- Grabs to on-board memory (SDRAM) with concurrent transfer between on-board memory and the VMChannel or another PCI device.
- PCI data transfers can be concurrent with Host processor access to on-board memory.

General features

Some general features of the VIA are:

- Bi-directional image exchanges between SDRAM and the VMChannel.
- Grab logic that can be used to handle a second VM input stream when the grab port is not used.
- VMChannel resources that can be used to copy images.
- Image alignment to one-pixel accuracy.
- Various 8, 16, 24, and 32 bits/pixel formats and multiplexing.
- Support of multiple overlapping video windows on grab and VMChannel transfers. The overlapping areas are handled using pixel mixing, on a pixel-by-pixel basis, with a 1-bit/pixel tag buffer (pixel mask).
- Color plane separation of image input (grab or VM) on two, three, or four 8-bit or 16-bit components. The same mechanism can be used to merge line segments of monochrome multi-tap cameras.

Grab port

The VIA's 32-bit grab port supports grabbing from up to four (8-bit) synchronized channels simultaneously, with each channel having its own destination address and pixel mask. The port is programmable to accept continuous or single-frame/field/line data in progressive, interlaced, or line scan (at up to 64K pixels/line) input modes. It is configurable as follows: 1 x 32-bit, 2 x 16-bit, 4 x 8-bit, and generates start-of-grab, end-of-grab, and grab line interrupts towards either the 'C80 or the Host.

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The grab port also:

- Accepts monochrome or RGB data input (one to four channels).
- Allows the programming of a horizontal grab window of 8 to 64K pixels in one-pixel increments, and a vertical grab window of 1 to 64K lines in one-line increments.
- Provides an input rate of 50 MHz in 32-bit mode.
- Provides various signals (pixel valid, hsync, vsync, and field) for a versatile interface.
- Supports an external trigger.
- Supports region-of-interest grab (input cropping).
- Supports independent horizontal and vertical subsampling (x2 - x16) and zooming (x2 or x4) on input.
- Supports various types of multi-tap cameras. For example, it can acquire from a digital, multi-tap camera that outputs non-consecutive pixels simultaneously (e.g., 0, 512 on one clock cycle, followed by 1, 513, etc.). The VIA takes this non-consecutive pixel data and reconstructs it appropriately, in real time. The VIA's grab port can also acquire from a digital, multi-tap camera that acquires as follows: for a 1024 x 1024 image, the camera outputs pixel 0 and pixel 1023 simultaneously on one clock cycle, then pixels 1 and 1022, etc., until convergence at pixels 511 and 512.

VMChannel port

The VIA's VMChannel port provides a 32-bit interface that operates at a maximum frequency of 33 MHz on a backplane system, or 25 MHz over a 68-wire ribbon cable system. It generates start-of-transfer, end-of-transfer, and line transfer interrupts towards the 'C80 or Host processor. The VMChannel also:

- Provides input/output modes of 8, 16, 24, and 32 bits/pixel.
- Provides a maximum transfer window size of 64K by 64K.
- Supports independent horizontal and vertical scaling on input and output.

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SDRAM interface

The VIA's 'C80 port is 64-bit wide and operates at up to 50 MHz for a peak bandwidth of 400 MBytes/sec. It decodes 'C80 accesses to memory, registers, and off-board resources. Through this connection, the 'C80 can directly access the whole 4-GByte PCI space (without paging). It supports connection to the 'C80, to SDRAM, and to the NOA.

The VIA's 64-bit SDRAM and NOA are connected through the 'C80 port.

PCI port

The VIA's PCI port is 32 bits wide and operates at 33 MHz. It allows all VIA resources to be accessed through a 128-MByte memory region, mappable anywhere in the 4-GByte PCI address space. In addition,

- VIA-initiated PCI transfers support all plane and pixel formats. This is achieved by using some of the VMChannel input/output capabilities. Therefore, VM and VIA-initiated PCI transfers cannot be performed simultaneously.
- Random accesses to SDRAM buffers are directly mapped on the PCI bus.
- For efficient 'C80 and Host accesses, the independent read prefetch and write posting buffers are integrated.

ARP

The VIA's ARP (Automatic Register Programming) is a mechanism used to dynamically program on-chip and external grab module registers. It operates independently of the 'C80 or Host processor. Its programming data (register values) are obtained automatically from a list stored in on-board or system memory.

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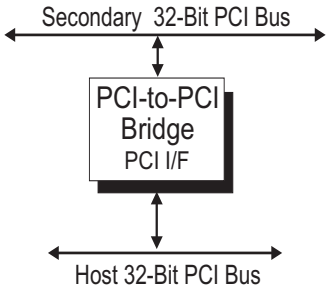
VMChannel

Genesis provides a 32-bit Controller/Master/Slave VESA Media Channel for high-speed connection between on-board and external devices (not necessarily a Matrox board). On a 68-wire ribbon cable system, the VMChannel runs at 25 MHz for 100 MBytes/sec peak transfer rates. On a backplane system, it runs at 33 MHz for 132 MBytes/sec peak transfer rates.

The PCI bus

Genesis uses a PCI (Peripheral Component Interface) 32-bit data bus that uses a 5V signaling environment. Using a PCI-to-PCI bridge, Genesis incorporates a secondary (local) PCI bus in addition to accessing the primary (Host) PCI bus. These buses are capable of a 132 MBytes/sec peak transfer rate.

PCI-to-PCI bridge



The PCI-to-PCI bridge isolates traffic between devices on the primary PCI bus and the secondary PCI bus.

The data transfer rate between the system bus master and the target memory (across the PCI bridge), in various read/write combinations, is highly dependent on the Host.

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Grab

Genesis supports two types of grabs:

- Digital acquisition through the grab port interface, provided all sync signals are supplied to the board.
- Analog digitization and full digital acquisition through the Genesis optional grab module.

All grabbed data can be sent to the processing section, the display section, and other Genesis boards simultaneously.

The grab port is described in the *Data transfer* section of this chapter.

For details on the optional grab module, see Chapter 7.

Display

You can display data using the optional Genesis display section or by transferring data to external display facilities (connected by the PCI bus or the VMChannel).

For details on the optional display section, see Chapter 8.

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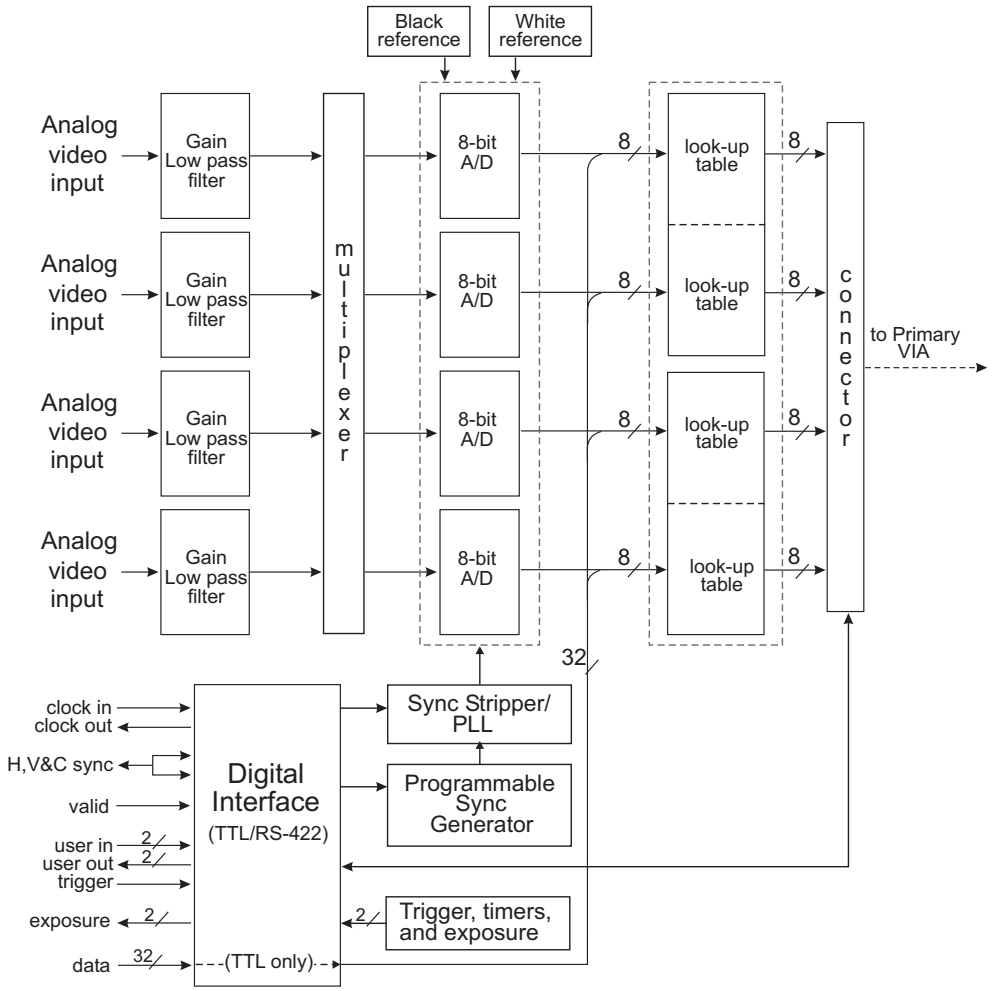
Chapter 7: Matrox Genesis Optional Grab Module

This chapter explains the architecture of the Matrox Genesis optional grab module, as well as its features and modes.

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Genesis Grab Module

The Genesis grab module is a daughter board that supports real-time acquisition of analog or digital data in either monochrome or color. Following is an illustration of the grab module:



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Digitizer configuration file

To set up the grab module, check the \GENESIS\DCF directory for a digitizer configuration file (*.*dcf*) that matches or is very similar to your video source type. The Genesis software uses this *.dcf* file to define how the digitizer should accept or generate video timing signals, such as horizontal sync, vertical sync, pixel clock, and video format signals (for example, TTL and RS-422). The *.dcf* file also indicates the data input mode: progressive, interlaced, or line scan (up to 64K pixels per line).

If you find a *.dcf* file that is suitable for your video source but need to adjust some of the more common parameters, you can do so directly, without adjusting the file, using the appropriate Genesis Native Library command. For more specialized adjustments, you can adjust the file itself, using Matrox INTELLICAM.

If you cannot find a suitable *.dcf* file, you can create your own, also using Matrox INTELLICAM. For more information on this program, refer to the *Matrox INTELLICAM User Guide*.

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Synchronization

Genesis can operate in either **slave** or **master** mode.

Slave mode

In **slave** mode, the video source provides the synchronization information to Genesis. It can accept any one of the following synchronization schemes:

- Synchronization signals encoded on one of the analog video signals provided to the board.
- Horizontal and/or vertical or composite synchronization signals supplied separately by the video source, in either TTL or RS-422 format.

Master mode

In **master** mode, Genesis generates the horizontal and/or vertical synchronization signals and supplies them to the video source. This allows the video source to synchronize to the board.

Trigger

Genesis accepts a trigger input to support acquisition related to external events. One trigger input can be found on the digital interface, in either TTL or RS-422 format. A second trigger input can be found on the analog input port.

Exposure

Genesis also has two software or hardware-retriggerable timers that can output signals. These timers let you control the video source exposure time and other related external events.

The controls for the trigger and timers, as well as other video source settings, are configured in the *.dcf* file. You can, however, change these settings, using the appropriate Genesis Native Library command.

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The phase-locked loop

The high-performance, low-jitter phase-locked loop (PLL) uses frequency synthesis techniques to generate the clock signal.

The PLL can use the following sources as a reference:

- The on-board crystal oscillator.
- The horizontal video synchronization signal supplied by the video source (line-locked mode).
- The clock signal supplied by the video source (to generate a different clock).

When using a signal from the video source as a reference, the PLL can produce a clock signal that is phase-shifted from this reference or a multiple of it. Phase-shifting allows you to fine-tune the location at which the video signal is sampled so that you can compensate for errors when digitizing close to or at the Nyquist frequency.

When in line-locked mode and accepting a composite video signal, the PLL can synchronize to either serrated or block vertical synchronization signals.

Operating frequency range	5 to 45 MHz
Jitter	±3 ns (when using a stable reference)
Phase adjustment	0° to 270° in 90° increments

When the input source supplies a sampling clock that does not require adjustment, the PLL is bypassed to avoid adding jitter to the supplied clock.

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The programmable synchronization generator

The programmable synchronization generator (PSG) performs various functions related to video synchronization and control:

- It supplies a feedback signal to the PLL, allowing it to lock to a reference signal. The PSG is then fully responsible for the sampling clock frequency.
- It can generate (in **master** mode) synchronization signals (horizontal, vertical, and composite sync) that can be used to genlock several video sources.
- It supplies the required control signals (H&V sync, field, valid, and capture) to the processing section.
- It provides support for standard interlaced and non-interlaced video.

Note, asynchronous camera control is performed by the VIA.

Using Matrox INTELLICAM, you can set the active video region, the sampling clock, and all the other parameters related to the timing of the video signal (that is, standard and non-standard video, interlaced or non-interlaced) in your digitizer configuration file (*.dcf*).

Once this is done, some of the video parameters can be changed, using the appropriate Genesis Native Library command.

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Analog input

The analog input section includes the electronic circuits needed to select, amplify, filter, and drive the video signal prior to sending it to the analog-to-digital (A/D) converter.

Genesis has four independent, wide-band (35 MHz) analog channels. This means that, when you are using a color camera, there is a separate channel for each color component. When using monochrome cameras, the four channels support simultaneous input from up to four cameras. However, this is true **only** if all cameras are genlocked.

The analog section can also be configured so that the same video signal drives two or four A/Ds. By using more than one A/D to sample the same video signal and clocking each A/D with a different phase-shifted clock, the overall effective sampling rate can be doubled or quadrupled.

# of channels used	Channel #	Sampling rate	# of A/Ds per channel used
4	0, 1, 2, 3	35 MHz	1
2	0, 1	70 MHz	2
1	0	140 MHz	4

You can also independently select the signal gain on each input channel using the appropriate Genesis Native Library command. This means you can optimize the amplitude of the video input signal seen by each A/D converter such that the full dynamic range is used for each of the four 8-bit A/Ds.

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The supported gain factors are as follows:

Gain	Maximum Input Voltage
2.0	1.0V max.
2.7	0.7V
3.3	0.6V
4.1	0.5V

The filtering stage is used to limit high frequency noise and cut the aliasing effects at the input of the A/D converter. The software allows you to switch between low pass (10 MHz) and all pass filtering.

Digital input

The TTL/RS-422 interface supports the transfer of digital signals such as horizontal, vertical, and composite sync, clocks, and exposures. All of these signals can be accessed directly, using the digital cable adapter board. Also, the interface provides access to two programmable user inputs (TTL/RS-422), two programmable user outputs (TTL/RS-422), and three auxiliary outputs (TTL only).

Adding the optional digital data input board (GEN-DIG-BRD/S) provides support for digital cameras with up to 32 bits of data, in RS-422 format.

For diagrams of the digital cable adapter board and the digital data input board, as well as their installation procedure, see Chapter 2.

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8-bit A/D converter and reference levels

Genesis uses high-quality, high-speed, 8-bit analog-to-digital converters to sample the video signal. Hence, Genesis provides excellent digitization quality, even at the highest sampling frequency. The A/D converters also feature a wideband input section, allowing full use of its sampling speed.

The black and white reference levels can be set separately, using the appropriate Genesis Native Library command. Each can be set to any value between 0 and 255. Each level corresponds to approximately 10 mV. The DC restoration level is also programmable, from 0.0 to 2.5V, in increments of 0.3 mV.

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Lookup tables (LUTs)

Genesis has four 8-bit programmable input look-up tables (LUTs). You can use these LUTs to remap an incoming video stream in either RGB mode or pseudo-color (color index) mode.

RGB mode

In RGB mode, each of the four channels is 8 bits in/8 bits out. With analog acquisition, each LUT can map up to two 8-bit channels (the grab module supports only 8-bit analog acquisition). With digital acquisition, each LUT can map one channel of up to 16 bits, or up to two channels of 8 bits. This mode can be used for analog or digital acquisition to grab data from one or more channels.

Color index mode

In color index mode, the same data is sent to three 8K components of the same LUT, producing a pseudo-color effect. Color index mode can be used, for example, to produce a 24-bit, pseudo-color output (valid only with data between 8 and 13 bits) or to format more than 8 bits of input data to 8 bits of output data.

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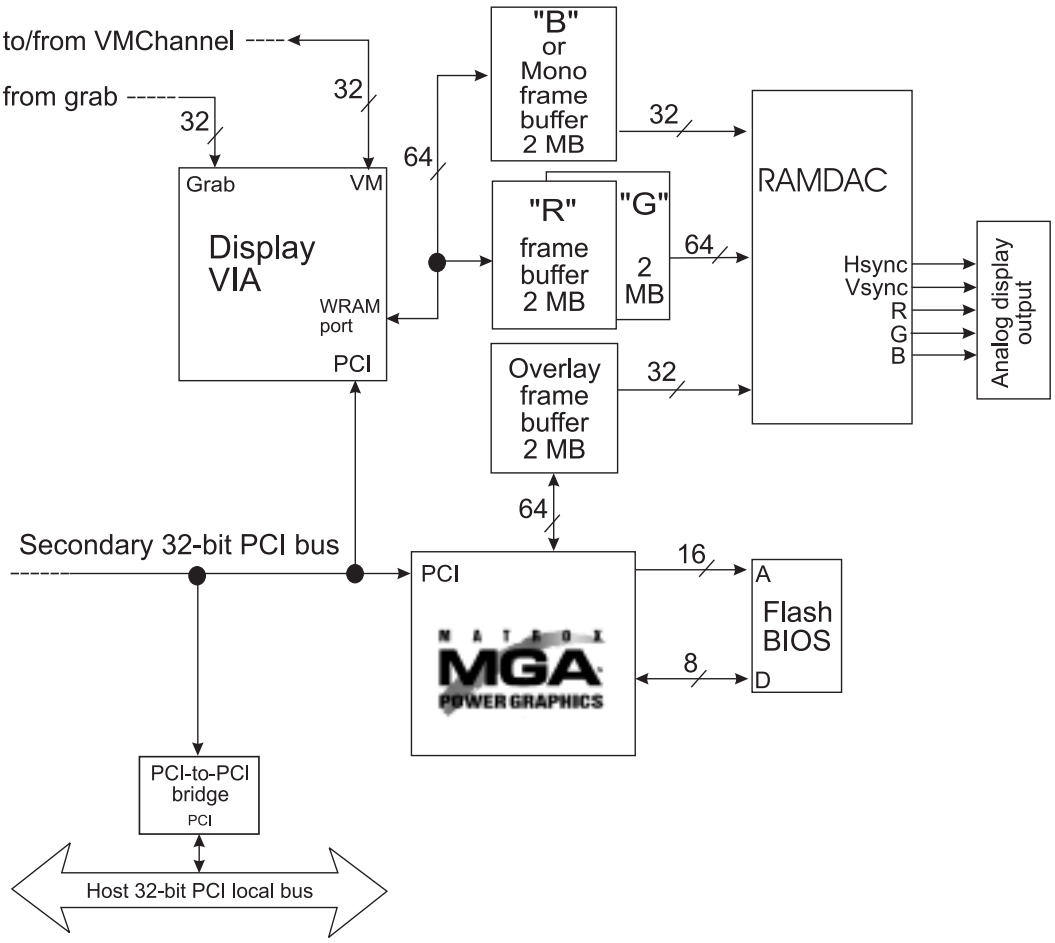
Chapter 8: Matrox Genesis Optional Display Section

This chapter explains the architecture of the Matrox Genesis optional display section, as well as its features and modes.

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Genesis display section

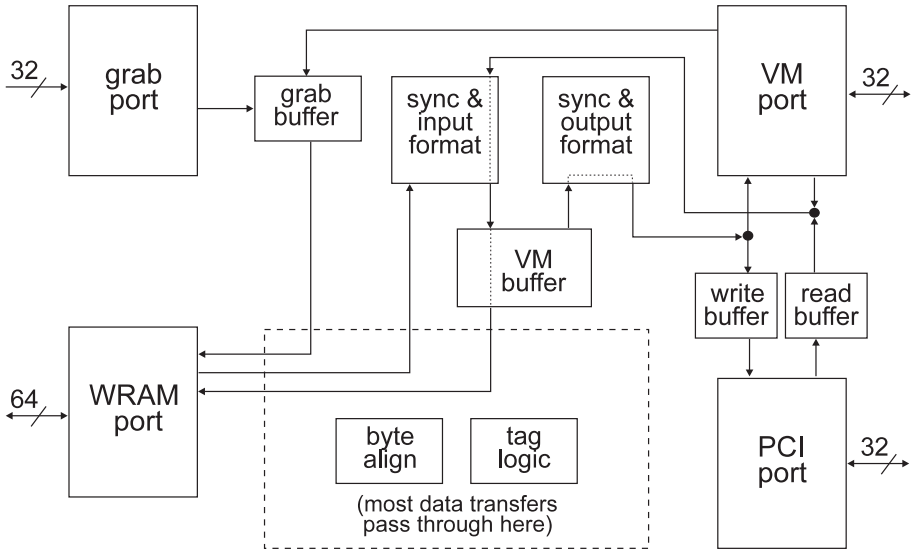
The optional Genesis display section provides high-resolution display from memory that is physically distinct from processing memory. Following is an illustration of the display section of Genesis.



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The display VIA

The display VIA is a high-performance chip that links various interfaces: the grab port, the VMChannel, the WRAM, and a PCI bus (as a master or a slave). Following is a block diagram of the display VIA:



Display VIA vs. primary VIA

The display VIA has almost all the functionality of the primary VIA. The exceptions are as follows:

- The display VIA is not concerned with the processing components (the 'C80 and NOA).
- The on-board memory references are to the display WRAM rather than the processing SDRAM.

WRAM

The VIA's WRAM connection accesses up to three 2 MByte banks of 2 256K x 32 WRAMs running at 50 MHz. It provides independent 24-bit WRAM write masks for Host, grab, and VMChannel transfers.

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The VIA and the VMChannel

When the VIA is operating in display mode, the VMChannel extracts any 8-bit field of a 16-bit or 32-bit output transfer for display. It also expands RGB 5:5:5 and 5:6:5 input to three 8-bit planes for display.

Main and overlay frame buffers

WRAM

Matrox Genesis has separate main (image) and overlay (VGA) buffers. The overlay buffer provides non-destructive overlay of desktop and/or text and graphics onto the contents of the main frame buffer. The main frame buffer can be 2 or 6 MBytes of WRAM. Monochrome applications can use 2 MBytes of the main frame buffer, for resolutions up to 1600 x 1200 x 8. For displaying 24-bit true color video, 6 MBytes of the main frame buffer can be used, for resolutions up to 1600 x 1200 x 24. The overlay frame buffer is a separate bank of 2 MBytes of WRAM, for up to 1600 x 1200 x 8-bit pseudo-color overlay.

Note that, on the Genesis-LC, display memory is used for displaying images and for buffering PCI transfers to the Host.

Keying

You can overlay text and 8-bit pseudo-color graphics on the main frame buffer using a specified color key. Once keying is enabled, the key color can be set using the appropriate Genesis Native Library command.

Setting resolution

In single-screen mode, configure the overlay frame buffer to the desired resolution using the VGA setup. The main frame buffer automatically uses the same resolution. If you are not using Genesis as the main VGA, set the resolution of the Genesis display using the appropriate Genesis Native Library command.

Display effects

You can move around images larger than the display resolution using pan and scroll features. You can also zoom in on images by a factor of 2 or 4. Zoom, pan, and scroll are only display effects and do not modify the data in the frame buffers.

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The RAMDAC

A 128-bit RAMDAC provides digital-to-analog conversion. It supports the display of captured images in real time, at a maximum resolution of 1600 x 1200 and a non-interlaced refresh rate of 85 Hz.

The RAMDAC has three 8-bit LUTs that map the contents of the overlay frame buffer. If the overlay frame buffer is not being used, the LUTs can be used to map the contents of the main frame buffer.

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Appendix A: Glossary

This appendix defines some of the specialized terms used in the Genesis documentation.

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- **ALU**

  Arithmetic and Logic Unit. The hardware used to perform arithmetic and logical operations.

- **ASIC**

  Application-specific integrated circuit. A custom-made integrated circuit made to meet the requirements of a specific application by integrating several digital and/or analog functions into a single die. Integrating the functions into a single die results in a reduction in cost, board area, and power consumption, while improving performance when compared to an equivalent implementation using off-the-shelf components.

- **Asynchronous function**

  A function that queues its command to the hardware and then immediately returns control to the caller.

  See also *synchronous function*.

- **Backplane**

  A circuit board that acts as a pathway between multiple Genesis boards. If a backplane is inserted between the grab ports of Genesis boards and one is inserted between the VMChannels of these boards, the boards are part of the same system and can share data through their VMChannel and grab port interface.

- **Band**

  One of the surfaces of a buffer. A grayscale image requires just one band. A color image requires three bands, one for each color component.

- **Bandwidth**

  A term describing the capacity to transfer data. Greater bandwidth is needed to sustain a higher transfer rate. Greater bandwidth can be achieved, for example, by using a wider bus.

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- **Bicubic interpolation**

  An interpolation mode that takes a weighted average of the sixteen pixels nearest a point. The pixels closest to the point are given the most weight. Bicubic interpolation produces more accurate results than bilinear interpolation but is slower.

- **Bilinear interpolation**

  An interpolation mode that takes a weighted average of the four pixels nearest a point. The pixels closest to the point are given the most weight. Bilinear interpolation produces less accurate results than bicubic interpolation (it tends to blur the image slightly). However, it is faster than bicubic interpolation.

- **Binarize**

  To convert data to one of two values.

- **Bit**

  A digit of a binary number. An image is referred to as 1-bit, 8-bit, 16-bit, etc., meaning that many bits are available to store the value of each pixel in the image.

- **Broadcast**

  To send data to multiple memory banks at the same time. On Matrox Genesis, this can be done for data passing through the grab port and the VMChannel, but not for data passing through the PCI bus.

- **Blanking period**

  The portion of a video signal after the end of a line or frame, and before the beginning of a new line or frame. During this period, the video signal is "blank" so that a scan line can be brought back to the beginning of the new line or frame. The portion of a video signal after the end of a line and before the beginning of a new line is known as the *horizontal blanking period*. The portion of a video signal after the end of a frame and before the beginning of a new frame is known as the *vertical blanking period*.

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- **Blob**

  An area of touching pixels that have the same value. Horizontally and vertically adjacent pixels are considered touching. Usually, you can specify whether diagonally adjacent pixels are considered touching. Pixels in the image that are not part of a blob make up the background.

  Also known as a *connected region*.

- **Buffer pitch**

  The number of bytes from a pixel to its neighboring pixel on the line below. Note that a buffer's pitch is not necessarily the same as its width in bytes, since the buffer could be a child buffer or could have been allocated with some padding at the end of each line.

  Also known as *line pitch* or *pitch*.

- **Byte-aligned**

  Describes a packed binary buffer which starts on an 8-bit boundary, that is, whose first pixel represents bit 0 of a data byte. Note that packed binary buffers are byte-aligned when allocated; the only way to have a misaligned packed binary buffer is to create a child buffer with an origin that is not a multiple of 8.

- **'C80**

  A single-chip multiprocessor device that performs most of the processing on the Genesis board. It includes four parallel processors (these are advanced, 32-bit integer DSPs), a 32-bit RISC master processor with an IEEE-754 floating-point unit, and a transfer controller (this transfers data between external and internal memory). The 'C80 is much more flexible than custom ASICs or other specialized hardware because it is fully programmable.

  Also known as the *TMS320C80*.

- **C-binding**

  The set of functions, callable from a Host C (or C++) application, available for controlling the Genesis system.

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- **Child buffer**

  A buffer corresponding to a rectangular region within another buffer, or to a specific band of a multi-band buffer. Child buffers are therefore useful when you want to restrict processing to a rectangular region of a buffer, or to a band of a buffer.

- **Clip**

  To replace overflows (or underflows) in an operation with the highest (or lowest) possible value that can be held in the destination buffer of the operation.

- **Closing**

  A dilation followed by an erosion.

  See also *opening*.

- **Color component**

  One of the components that make up a color space. Typically, each component of a color image is stored in a separate band of a multi-band buffer.

- **Color space**

  The way color information in a color image is represented. Common color spaces are RGB and HSL.

- **Composite sync**

  A synchronization signal made up of two components: one horizontal and one vertical.

- **Compression ratio**

  The ratio of the uncompressed data size of an image to its compressed data size.

- **Compute bound**

  Describes a function whose performance is limited strictly by the speed at which the 'C80 can process the data, and not by other factors such as how fast the data can be accessed in memory.

  See also *I/O bound*.

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- **Connected region**

  See *blob*.

- **Contiguous memory**

  A block of memory occupying a single, unbroken series of addresses.

- **Control buffer**

  A buffer whose control fields specify certain options of a function. The Genesis Native Library uses control buffers because some functions have so many options that it is impractical to have these options as parameters of the function. Instead, you specify the options you want performed by adding the required control fields to a buffer and passing this buffer to the function.

- **Control field**

  A field that is used to specify a certain option of a function. The option is performed by adding the field to the function's control buffer. A field holds a single value (integer or floating-point) and is identified by a unique "tag". The tag itself is just an integer value.

- **Convolution**

  A neighborhood operation that determines the new value for a pixel based on the weighted sum of the pixel and the pixel's neighboring values.

- **Dilation**

  A morphological operation that adds layers to objects in an image. In general, this is done by changing background pixels that touch object pixels into object pixels.

  See also *erosion*.

- **Display artifacts**

  Unwanted visual effects sometimes seen when the transfer of data to display memory is not synchronized with the reading of display memory by the RAMDAC.

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- **Display buffer**

  See *main frame buffer*.

- **Double buffering**

  Alternating the destination of an operation between two buffers. Double buffering allows you to, for example, process one buffer while grabbing into the other buffer.

- **DSP**

  Digital Signal Processor. Microprocessor designed for high-speed processing of digital signals.

- **Dual-screen mode**

  A display configuration using two monitors; one to display images from the Genesis display memory, and another to display the Host operating system's user interface.

  See also *multi-display mode* and *single-screen mode*.

- **Dynamic range**

  The range of values present in a buffer. An unsigned 8-bit buffer, for example, has an allowable range of 0 to 255; its dynamic range can be any range within these values.

- **Erosion**

  A morphological operation that peels layers from objects in an image. In general, this is done by changing object pixels that touch background pixels into background pixels.

  See also *dilation*.

- **Exposure signal**

  The signal generated by one of the programmable timers of the grab module. The exposure signal can be used to control external hardware. For example, it can be fed to the camera to control its exposure time or used to fire a strobe light.

- **Exposure time**

  Refers to the period during which the image sensor of a camera is exposed to light. As the length of this period increases, so does the image brightness.

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- **Field**

  One of the two halves that together make up the image grabbed from an interlaced camera. One half consists of the image's odd lines (known as the *odd field*); the other half consists of the image's even lines (known as the *even field*).

- **Fixed-point**

  A format for representing non-integer values that contains a fixed number of digits for the integer and fractional parts. A 16-bit fixed-point buffer, for example, might contain 8 integer bits and 8 fractional bits. Fixed-point buffers are a compromise between floating-point and integer buffers, since they offer the speed of integer processing with some of the precision of floating-point processing.

- **Floating-point**

  A format for representing numbers that contains two parts: a mantissa and an exponent. The mantissa specifies the digits in the number, while the exponent expresses the magnitude of the number. This format provides a constant number of significant digits of precision over a very large dynamic range. Floating-point buffers take longer to process than integer buffers.

- **Frame**

  A single image grabbed from a video camera.

- **Gain level**

  The factor by which an analog input signal is scaled. The gain affects the brightness and contrast of the resulting image.

- **Gain and offset correction**

  To offset and multiply each pixel in an image by specified values:
  *new pixel value = (old pixel value - offset) * gain*.
  The offset and gain values can be constant for the whole image, or they can be different for each pixel. The latter can be useful when performing shading corrections.

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- **Geometric operation**

  A processing operation that repositions pixels in an image.

- **Grab**

  To acquire an image from a camera.

- **Histogram**

  A statistical operation that measures the frequency with which each pixel value occurs in an image.

- **Histogram equalization**

  A point-to-point operation that changes each pixel value in an image so as to reshape the image's histogram in a specified way. A histogram equalization operation can be used to improve the contrast or brightness of an image.

- **Horizontal blanking period**

  The portion of a video signal after the end of a line and before the beginning of a new line. During this period, the video signal is "blank".

  See also *vertical blanking period*.

- **Horizontal sync**

  The part of a video signal that indicates the end of a line and the start of a new one.

  See also *vertical sync*.

- **HSL**

  A color space that represents color using components of hue, saturation, and luminance. The hue component describes the actual color of a pixel. The saturation component describes the concentration of that color. The luminance component describes the combined brightness of the primary colors.

- **In-place operation**

  Describes a processing operation in which the results overwrite one of the source buffers.

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- **Interlaced scanning**

  Describes a transfer of data in which the odd-numbered lines of the source are written to the destination buffer first, and then the even-numbered lines (or vice-versa).

  See also *progressive scanning*.

- **Interpolation**

  A neighborhood operation that estimates the intensity at a point in an image between pixel positions. To estimate the intensity, the operation takes a weighted-sum of the point's neighboring pixel values. Two common interpolation modes are *bicubic interpolation* and *bilinear interpolation*.

- **I/O bound**

  Describes a function whose performance is limited by the speed at which it can access data in memory.

  See also *compute bound*.

- **JPEG**

  Joint Photographic Experts Group. A standard for compressing images.

- **Kernel**

  The set of numbers that are used by a neighborhood operation to determine new pixel values. The type of neighborhood operation determines how the kernel is used.

  Also known as a *structuring element* (particularly for morphological operations).

- **Keying**

  A display effect that switches between two display sources depending on the pixel values in one of the sources. On Genesis, keying is usually used to make portions of the overlay frame buffer transparent so that corresponding areas of the main frame buffer can show through it.

- **Latency**

  The time from when an operation is started to when the final result is produced.

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- **Line pitch**

  See *buffer pitch*.

- **Live processing**

  See *real-time processing*.

- **LUT mapping**

  Look-up table mapping. A point-to-point operation that uses a table to define a replacement value for each possible pixel value in an image.

- **Main frame buffer**

  The buffer whose contents are displayed by the display section of Matrox Genesis. If keying is enabled, those areas of the overlay frame buffer that have a specified color allow the main frame buffer to show through.

  Also known as the *display buffer*.

- **Message**

  The operation code and its various optional parameters that a C-binding function sends to the board so that the board can execute the function.

- **MGA**

  Matrox Graphics Architecture. As part of Matrox Genesis's display section, it allows you to draw into the overlay buffer using the graphics functions of the Host operating system.

- **Morphological operation**

  A neighborhood operation that determines the new value for a pixel based on the results of a comparison between the pixel's neighborhood and the operation's kernel, or based on the extreme values in the pixel's neighborhood.

- **Multi-display mode**

  A multi-board configuration that uses Genesis boards and/or MGA Millennium boards to create one large desktop on two, three, or four screens.

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- **Multi-processing**

  Executing two or more operations in parallel.

  Also known as *parallel processing*.

- **Neighborhood operation**

  A processing operation that replaces a pixel's value according to the values of its surrounding pixels (called its neighborhood). The size of the neighborhood is determined by the operation's kernel. The type of operation determines how the new pixel value is determined. Convolutions and morphological operations are two types of neighborhood operations.

- **NOA**

  Neighborhood Operations Accelerator. A Matrox-designed ASIC that can accelerate neighborhood operations such as convolutions and morphology.

- **Node**

  The basic building block of a Genesis system; it consists of the TMS320C80 ('C80), the VIA, and processing memory. A node can also include a NOA.

- **Normalized grayscale correlation**

  A neighborhood operation that determines the new value for a pixel (*r*), based on a specified kernel (model):

$$r = \frac{N\sum IM - \left(\sum I\right)\sum M}{\sqrt{\left[N\sum I^2 - \left(\sum I\right)^2\right]\left[N\sum M^2 - \left(\sum M\right)^2\right]}}$$

  where M = the value of a model pixel and I = the value of the underlying image pixel. Note that the above equation reaches its maximum value of 1 where the image and model match exactly, gives 0 where the image and model are uncorrelated, and is negative where the similarity is less than might be expected by chance (reaching -1 when the image is a negative version of the model). Normalized grayscale correlation is widely used in industry for pattern matching applications.

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- **Normalization**

  Adjusting the results of a processing operation so that they have the correct magnitude. After multiplying an image by a fixed-point integer, for example, normalization is needed to right-shift results to remove the fractional bits.

- **Off-screen display memory**

  Memory that is allocated in the main or overlay frame buffer (in Matrox Genesis's display section) that is not visible on the screen.

- **Opening**

  An erosion followed by a dilation.

  See also *closing*.

- **Operand**

  One of the terms of an arithmetic or logical operation. In the arithmetic operation $A + B$, for example, the operands are A and B. In the Genesis Native Library, one of the operands of an arithmetic or logical operation must be a buffer; the other(s) can be buffers or constants. Note that the buffers can hold any type of data, for example, image data, LUT values, and kernel values.

- **Overflows**

  Results of a processing operation that are above the range of the destination buffer. For example, in an unsigned 8-bit destination buffer, overflows are those results above 255.

  See also *underflows*.

- **Overlay frame buffer**

  The buffer used to annotate the main frame buffer. On Genesis, portions of the overlay frame buffer that have a specified color allow the corresponding areas of the main frame buffer to show through (if keying is enabled). Note that, in single-screen mode, the overlay frame buffer is also used to display the Host operating system's user interface.

- **Parallel processing**

  See *multi-processing*.

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- **Pitch**

  See *buffer pitch*.

- **Point-to-point operation**

  A processing operation that does not use a pixel's neighbors when determining the pixel's new value. Examples of point-to-point operations are LUT mappings, arithmetic operations, and logical operations.

- **Processing operation**

  An operation that results in a new image. Examples of processing operations are geometric operations, point-to-point operations, and neighborhood operations.

  See also *statistical operation*.

- **Progressive scanning**

  Describes a transfer of data in which the lines of the source are written sequentially into the destination buffer.

  See also *interlaced scanning*.

- **RAMDAC**

  Random Access Memory Digital-to-Analog Converter. A chip that converts data from digital to analog so that it can be displayed on a monitor. The RAMDAC can also implement various display effects.

- **Rank filter operation**

  A neighborhood operation that sorts a pixel's neighborhood values in increasing order, and then replaces the pixel's value with the *nth* highest value in the list. A *median filter* is a type of rank filter that uses the middle value in the list.

- **Real-time processing**

  The processing of an image as quickly as the next image is grabbed.

  Also known as *live processing*.

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- **Reference levels**

  The zero and full-scale levels of an analog-to-digital converter. Voltages below a *black reference level* are converted to a zero pixel value; voltages above a *white reference level* are converted to the maximum pixel value. Together with the analog gain factor, the reference levels affect the brightness and contrast of the resulting image.

- **RGB**

  A color space that represents color using the primary colors (red, green, and blue) as components.

- **RISC**

  Reduced Instruction Set Computing. A microprocessor design that focuses on efficiently processing a small set of instructions.

- **ROI**

  Region of interest. The area of a buffer that is processed. The region of interest can be the entire buffer or a rectangular portion of the buffer.

- **Run**

  A horizontal sequence of consecutive pixels with the same value. Often used in blob analysis, since each blob can be efficiently described as a list of runs.

- **Saturate**

  To replace overflows (or underflows) in an operation with the highest (or lowest) possible value that can be held in the destination buffer of the operation.

- **Scalability**

  Describes a board whose configuration is designed to include additional modules, if desired. The Genesis main board, for example, can include a display section and/or grab module. In addition, one or more processor boards can be added to increase performance.

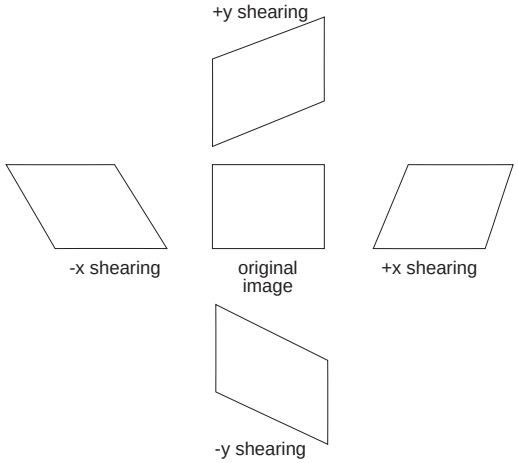
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- **SDRAM**

  Synchronous Dynamic Random Access Memory. A type of memory used for processing. SDRAM allows the 'C80 to access data as fast as possible, which is important for I/O-bound functions.

- **Shearing**

  A geometric operation that translates pixels along only one axis, by an amount proportional to the distance from that axis (see below).



- **Signed**

  Describes a buffer that can have negative values. A signed 8-bit buffer, for example, has values between -128 and 127.

  See also *unsigned*.

- **Sign-extension**

  To extend a value from one data type to a larger data type by copying the sign bit of the source type to all the higher bits of the destination (that is, by copying 1's if the value is negative; 0's if the value is positive).

  See also *zero-extension*.

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- **Single-screen mode**

  A display configuration using a single monitor to display both the Host operating system's user interface and images from the Genesis display memory.

  See also *dual-screen mode* and *multi-display mode*.

- **Spatial filtering operation**

  See *convolution*.

- **Statistical operation**

  An operation that extracts information from an image. A histogram is an example of a statistical operation.

  See also *processing operation*.

- **Structuring element**

  See *kernel*.

- **Synchronous function**

  A function that does not return control to the caller until it has finished executing.

  See also *asynchronous function*.

- **System**

  A group of Genesis boards (main board(s) and/or processor board(s)) connected to each other by the grab port and the VM port.

- **Temporal filtering**

  An operation that takes a weighted sum of the currently grabbed frame and the previous output of the filter operation. Temporal filtering is often used to remove the effects of random noise because it acts as an averaging filter.

- **Thickening**

  A morphological operation that converts background pixels into object pixels when the neighborhood exactly matches a kernel. Thickening is similar to dilation except that it is more selective because, when iterated, it will not convert all pixels to object pixels. Instead, it will eventually reach a steady state (known as *idempotence*).

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- **Thinning**

  A morphological operation that converts object pixels into background pixels when the neighborhood exactly matches a kernel. Thinning is similar to erosion except that it is more selective because, when iterated, it will not convert all pixels to background pixels. Instead, it will eventually reach a steady state (known as *idempotence*).

- **Thread**

  An execution queue. In the Genesis Native Library, all functions are sent to a specified thread, and execute on the node associated with this thread. Threads execute independently of one another, allowing operations to run in parallel.

- **Threshold**

  A point-to-point operation that converts pixels whose values are above, below, and/or within a specified range, to a specified value.

- **TMS320C80**

  See *'C80*.

- **Translation**

  A geometric operation that displaces an image vertically and/or horizontally.

- **Underflows**

  Results of a processing operation that are below the range of the destination buffer. For example, in an unsigned 8-bit destination buffer, underflows are those results below 0.

  See also *overflows*.

- **Unsigned**

  Describes a buffer that can have only positive values. An unsigned 8-bit buffer, for example, has values between 0 and 255.

  See also *signed*.

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- **Vertical blanking period**

  The portion of a video signal after the end of a frame and before the beginning of a new frame. During this period, the video signal is "blank".

  See also *horizontal blanking period*.

- **Vertical sync**

  The part of a video signal that indicates the end of a frame and the start of a new one.

  See also *horizontal sync*.

- **VIA**

  Video Interface ASIC. A custom ASIC that connects all the data buses on Matrox Genesis (the grab, VMChannel, 'C80 and PCI bus) to one another, and directs and monitors data flow "traffic" throughout the system. It is a video interface that provides various ways of inputting and outputting data.

- **VMChannel**

  Vesa Media Channel. An industry standard 32-bit bus designed for carrying video data. On Genesis, it is used primarily to copy images between nodes or from processing to display memory.

- **WRAM**

  Window Random Access Memory. A type of dual-ported memory used for displays.

- **Zero-extension**

  To extend a value from one data type to a larger data type by copying 0's into all the higher bits of the destination.

  See also *sign-extension*.

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Appendix B: Technical information

This appendix contains information that might be useful when installing your Matrox Genesis board.

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Technical information

This appendix contains information that might be useful when installing your Matrox Genesis board. The *Grab information* section might also be useful when using the Matrox INTELLICAM software.

System requirements

- A PC with a Pentium processor or better, and a PCI-bus architecture.

Δ ***Important***

Your PCI system's BIOS must be able to recognize a PCI-to-PCI bridge configuration and initialize the VGA display controller residing on the other side of the PCI bridge. A list of PC platforms compatible with Genesis can be found on our web site (**http://www.matrox.com/imaging**). If you are using a system that is different from those on the tested systems list, ask your PC manufacturer if your software meets the listed requirements.

Your system BIOS must be capable of mapping the VIA's memory requirements (i.e., 128 MBytes per VIA).

We recommend that you use a PCI system with a high-performance core-logic chipset (for example, Intel 430HX or 430VX) to obtain maximum functionality and performance from your Genesis.

- One empty, **full-length** 32-bit PCI expansion slot (master capable).
- Windows NT 3.51 (or later), or DOS version 6.22 (or later). Under Windows NT, you need at least 24 MBytes of system RAM. Under DOS, you need at least 4 MBytes of system RAM.
- A CD-ROM drive and a hard disk or network drive on which to install the Genesis software.

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Grab module

- Analog interface
  - 4 software-selectable video inputs
  - Four 8-bit analog-to-digital converters
  - Standard or non-standard monochrome video signal acquisition in 3 software-selectable modes:
    - 4 channels/8-bit mode at up to 35 MHz
    - 2 channels/8-bit mode at up to 70 MHz
    - 1 channel/8-bit mode at up to 140 MHz
  - 4 independent configurable input filters:
    - Low-pass filter with a cutoff frequency of 10 MHz
    - All-pass
- Digital interface
  - 32-bit digital TTL data interface
  - 32-bit digital RS-422 data (requires optional digital data input board)
  - Up to 30 MHz input rate in any one of several configurations:
    - four 8-bit channels
    - two 16-bit channels
    - one 32-bit channel
- Sync generator
  - Sync and timing FPGA (Field Programmable Gate Array) provides control for synchronization, triggering, exposure, and auxiliary inputs and outputs.

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- Synchronization and control
  - H & V sync, composite sync, pixel clock (TTL/RS-422)
  - Trigger input available through digital interface connector (TTL/RS-422) or through analog input connector (TTL only, optically isolated) can reset the acquisition hardware (synchronously or asynchronously).
  - Two exposure (timer) outputs (TTL/RS-422)
  - Two programmable user inputs (TTL/RS-422), two programmable user outputs (TTL/RS-422), and three programmable auxiliary outputs (TTL only)
- Video adjustment
  - Software-programmable input gain, offset, and references
  - Phase adjustment: 0° - 270°, 90° increments
  - Fully programmable and configurable input LUTs

    - four 256 x 8-bit

    - two 8K x 16-bit
  - Supported analog gain factors:

Gain	Maximum Input Voltage
2.0	1.0V max.
2.7	0.7V
3.3	0.6V
4.1	0.5V

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Display section

- Separate main (image) and overlay (VGA) frame buffers.
  - Main frame buffer, 2 or 6 MBytes of WRAM.
  - Monochrome applications require at least 2 MBytes of the main frame buffer, for resolutions up to 1600 x 1200 x 8.
  - 24-bit true color video applications require 6 MBytes of the main frame buffer, for resolutions of up to 1600 x 1200 x 24.
  - Overlay frame buffer has separate bank of 2 MBytes of WRAM, for up to 1600 x 1200 x 8-bit pseudo-color overlay.
- Dual-screen mode, where live video with overlay is displayed on one monitor, while the desktop is displayed on another monitor. (Note that a second display adapter is required to display the desktop).
- Multi-display mode, where (under Windows NT, using any combination of two to four main boards and/or Millennium boards) one large virtual desktop can be created and displayed across multiple monitors.
- 220 MHz RAMDAC.

Maximum vertical refresh rates

The following table shows the maximum vertical refresh rate supported by the corresponding resolution:

Resolution	**Refresh rate**
640 x 480	200 Hz
800 x 600	200 Hz
1024 x 768	130 Hz
1152 x 882	110 Hz
1280 x1024	100 Hz
1600 x 1200	85 Hz

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Default settings

- Boot video mode/resolution: VGA Mode 3 (80 characters, 25 lines)
- Memory map: system-determined
- On-board VGA: enabled

Electrical specifications

Operating voltage and current:

- 5 V ± 5%, 3.16 A / 15.8 W
- 12 V ± 5%, 500 mA / 6.0 W
- -12 V ± 10%, 100 mA / 1.2 W

23 W

❖ The above values are preliminary and subject to change.

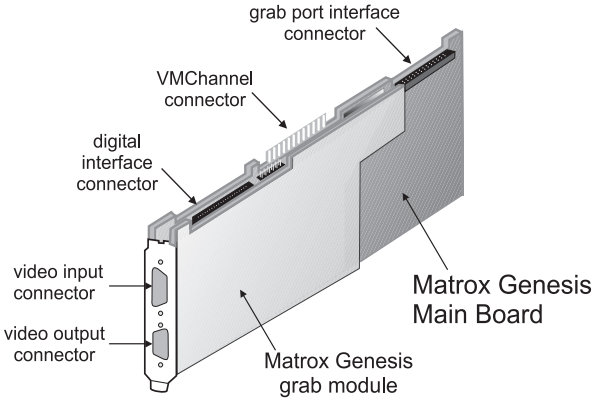
Environmental specifications

- Minimum/maximum ambient operating temperature: 0°C / 55°C.
- Minimum/maximum storage temperature: -40°C / 75°C.
- Operating humidity: 20 - 80% relative humidity (non-condensing).
- Storage humidity: 5 - 95% relative humidity (non-condensing).

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Connectors on the main board

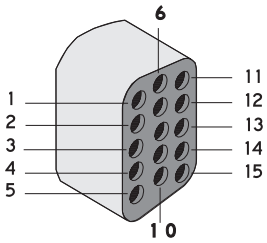
The Genesis main board has three connectors: a video output connector, a VMChannel interface, and the grab port II interface connector. If your board includes an optional grab module, it will have two additional connectors: the video input connector and the digital interface connector.



Video output connector

The video output connector is a standard DB-15 female connector that provides analog video and digital synchronization signals to the monitor. The pin assignment is compatible with VGA monitors and is as follows:

Pin assignment

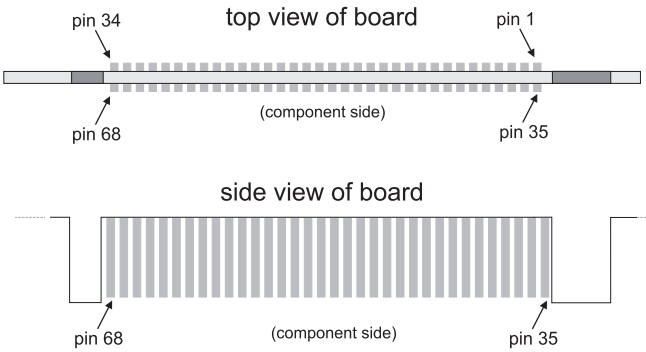


PIN	SIGNAL	PIN	SIGNAL
1	Red	9	Not used
2	Green	10	Ground
3	Blue	11	Monitor ID 0
4	Monitor ID 2	12	Monitor ID 1
5	Ground	13	Horizontal sync
6	Ground	14	Vertical sync
7	Ground	15	Monitor ID 3
8	Ground		

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VMChannel interface

The VMChannel interface allows multiple boards to share data through their VMChannel. A VMChannel backplane (available with the GEN-BUS/... interconnect kits) must be inserted across the VMChannel interfaces of the boards.



The following table provides the pinout of the VMChannel interface:

PIN	SIGNAL	PIN	SIGNAL
1	SAN	35	EVST[0]
2	EVST[1]	36	DGND
3	BSN[0]	37	BSN[1]
4	DGND	38	SNRDYN
5	CONTROL	39	DGND
6	RESETN	40	DGND
7	CLK	41	DGND
8	VMSENSE	42	DGND
9	MASK0	43	MASK1
10	DGND	44	DATA[0]
11	DATA[1]	45	DGND
12	DATA[2]	46	DATA[3]
13	DGND	47	DATA[4]
14	DATA[5]	48	DGND
15	DATA[6]	49	DATA[7]

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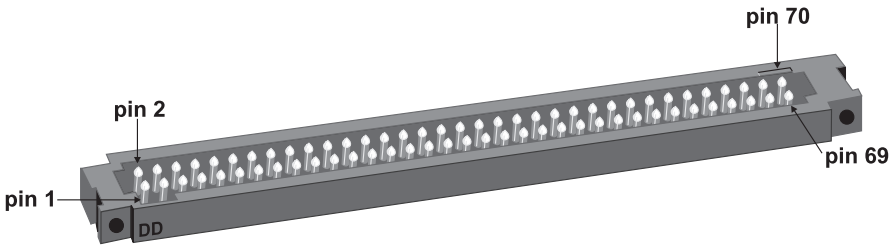
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PIN	SIGNAL	PIN	SIGNAL
16	DGND	50	DATA[8]
17	DATA[9]	51	DGND
18	DATA[10]	52	DATA[11]
19	DGND	53	DATA[12]
20	DATA[13]	54	DGND
21	DATA[14]	55	DATA[15]
22	DGND	56	DATA[16]
23	DATA[17]	57	DGND
24	DATA[18]	58	DATA[19]
25	DGND	59	DATA[20]
26	DATA[21]	60	DGND
27	DATA[22]	61	DATA[23]
28	DGND	62	DATA[24]
29	DATA[25]	63	DGND
30	DATA[26]	64	DATA[27]
31	DGND	65	DATA[28]
32	DATA[29]	66	DGND
33	DATA[30]	67	DATA[31]
34	DGND	68	SBN

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Grab port II interface connector

The grab port II interface connector allows multiple boards to share data through their grab port interface. A grab port interface backplane (available with the GEN-BUS/... interconnect kits) must be inserted across the grab port interface connectors of the boards.



The following table provides the pinout of the grab port II interface connector:

PIN	SIGNAL	PIN	SIGNAL
1	RESERVED	16	RESERVED
2	RESERVED	17	GP2SPARE[3]
3	RESERVED	18	GP2SPARE[2]
4	GP2SENSE	19	GP2SPARE[1]
5	RESERVED	20	GP2SPARE[0]
6	DGND	21	GP2CAPTURE
7	RESERVED	22	GP2VALID
8	GP2FIELD	23	DGND
9	GP2VSYNC	24	DGND
10	GP2HSYNC	25	GP2D[31]
11	RESERVED	26	GP2D[30]
12	GP2CLK	27	GP2D[29]
13	DGND	28	GP2D[28]
14	DGND	29	GP2D[27]
15	RESERVED	30	GP2D[26]

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PIN	SIGNAL	PIN	SIGNAL
31	GP2D[25]	51	GP2D[13]
32	GP2D[24]	52	GP2D[12]
33	DGND	53	GP2D[11]
34	DGND	54	GP2D[10]
35	RESERVED	55	GP2D[9]
36	RESERVED	56	GP2D[8]
37	GP2D[23]	57	RESERVED
38	GP2D[22]	58	RESERVED
39	GP2D[21]	59	RESERVED
40	GP2D[20]	60	RESERVED
41	GP2D[19]	61	GP2D[7]
42	GP2D[18]	62	GP2D[6]
43	GP2D[17]	63	GP2D[5]
44	GP2D[16]	64	GP2D[4]
45	DGND	65	GP2D[3]
46	DGND	66	GP2D[2]
47	RESERVED	67	GP2D[1]
48	RESERVED	68	GP2D[0]
49	GP2D[15]	69	DGND
50	GP2D[14]	70	DGND

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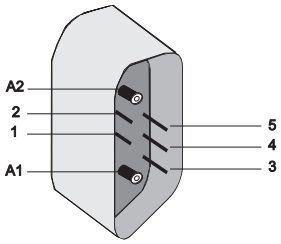
Connectors on the optional grab module

When the main board includes the optional grab module, it has two additional connectors: the video input connector and the digital interface connector.

Video input connector

The video input connector provides the analog video-input signals and the TTL trigger-input signal to the Genesis board. It is made up of a 7W2 connector with two coaxial and five regular pin contacts that can be connected to either a one-BNC connector or to a five-BNC connector. The pin assignment is:

Pin assignment



PIN	SIGNAL
A1	Analog video input 1 (red)
A2	Analog video input 2 (green)
1	TTL trigger input +
2	Ground
3	TTL trigger input -
4	Analog video input 4 (alpha)
5	Analog video input 3 (blue)

The Matrox cable used to interface to the video input connector is IMG-7W2-TO-1BNC or IMG-7W2-TO-5BNC. For customers providing their own cable, the female 7W2 connector can be purchased from FCT or from ITT Cannon. Part numbers are:

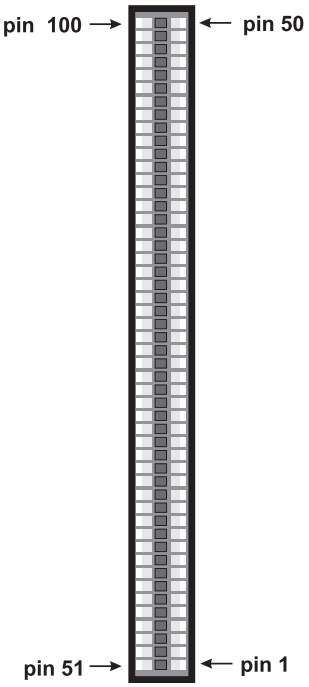
Component	FCT Part No.	ITT Cannon Part No.
Connector	FM7W2P12-K338	DAMC7W2PJK87
Mating connector: Coaxial housing	FM7W2S-K121	DAM7W2SMA197
Mating connector: Shielded metalized plastic backshell	FKC2GA	DA121073-150
Mating connector: Extended jackscrew	Not applicable	250-8501-010
Mating connector: 75-Ohm contact	FMX003S102	DM53742-31

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Digital interface connector

The digital interface connector on the optional grab module is used to connect to the digital cable adapter board or to the optional digital data input board (P/N: GEN-DIG-BRD/S).

The following table provides the pinout of the digital interface connector:



PIN	SIGNAL	PIN	SIGNAL
1	GND	23	HSYNC, INPUT, 422-
2	HSYNC, INPUT, TTL	24	VSYNC, INPUT, 422+
3	VSYNC, INPUT, TTL	25	VSYNC, INPUT, 422
4	CSYNC, INPUT, TTL	26	CSYNC, INPUT, 422+
5	GND	27	CSYNC, INPUT, 422-
6	CLOCK, INPUT, TTL	28	CLOCK, INPUT, 422+
7	GND	29	CLOCK, INPUT, 422-
8	TRIGGER(0), INPUT, TTL	30	USER(0), INPUT, 422+
9	VALID, INPUT, TTL	31	USER(0), INPUT, 422-
10	USER(0), INPUT, TTL	32	VALID, INPUT, 422+
11	GND	33	VALID, INPUT, 422-
12	HSYNC, OUTPUT, TTL	34	TRIGGER(0), INPUT, 422+
13	VSYNC, OUTPUT, TTL	35	TRIGGER(0), INPUT, 422-
14	CSYNC, OUTPUT, TTL	36	HSYNC, OUTPUT, 422+
15	GND	37	HSYNC, OUTPUT, 422-
16	CLOCK, OUTPUT, TTL	38	VSYNC, OUTPUT, 422+
17	GND	39	VSYNC, OUTPUT, 422-
18	EXPOSURE(1), OUTPUT, TTL	40	CSYNC, OUTPUT, 422+
19	EXPOSURE(2), OUTPUT, TTL	41	CSYNC, OUTPUT, 422-
20	USER(0), OUTPUT, TTL	42	CLOCK, OUTPUT, 422+
21	GND	43	CLOCK, OUTPUT, 422-
22	HSYNC, INPUT, 422+	44	USER(0), OUTPUT, 422+

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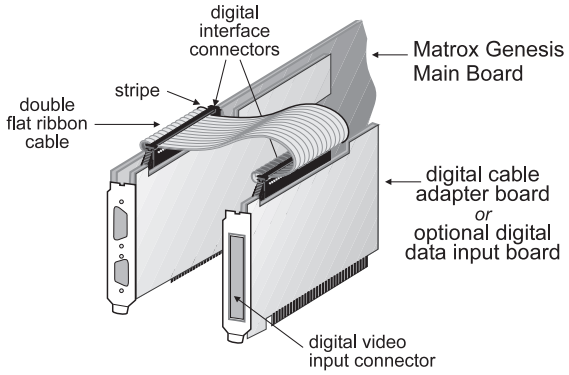
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PIN	SIGNAL	PIN	SIGNAL
45	USER(0), OUTPUT, 422-	73	DATA(17), I/O, TTL
46	EXPOSURE(1), OUTPUT, 422+	74	GND
47	EXPOSURE(1), OUTPUT, 422-	75	DATA(18), I/O, TTL
48	EXPOSURE(2), OUTPUT, 422+	76	DATA(19), I/O, TTL
49	EXPOSURE(2), OUTPUT, 422-	77	DATA(20), I/O, TTL
50	MODULE PRESENT I/O TTL	78	DATA(21), I/O, TLL
51	GND	79	GND
52	DATA(0), I/O, TTL	80	DATA(22), I/O, TTL
53	DATA(1), I/O, TTL	81	DATA(23), I/O, TTL
54	GND	82	DATA(24), I/O, TTL
55	DATA(2), I/O, TTL	83	DATA(25), I/O, TTL
56	DATA(3), I/O, TTL	84	GND
57	DATA(4), I/O, TTL	85	DATA(26), I/O, TTL
58	DATA(5), I/O, TTL	86	DATA(27), I/O, TTL
59	GND	87	DATA(28), I/O, TTL
60	DATA(6), I/O, TTL	88	DATA(29), I/O, TTL
61	DATA(7), I/O, TTL	89	GND
62	DATA(8), I/O, TTL	90	DATA(30), I/O, TTL
63	DATA(9), I/O, TTL	91	DATA(31), I/O, TTL
64	GND	92	USER(1), OUTPUT, TTL
65	DATA(10), I/O, TTL	93	USER(1), INPUT, TTL
66	DATA(11), I/O, TTL	94	USER(1), OUTPUT, 422+
67	DATA(12), I/O, TTL	95	USER(1), OUTPUT, 422-
68	DATA(13, I/O, TTL	96	USER(1), INPUT, 422+
69	GND	97	USER(1), INPUT, 422-
70	DATA(14), I/O, TTL	98	MODULE DATA, OUTPUT, TTL
71	DATA(15), I/O, TTL	99	MODULE CLOCK, OUTPUT, TTL
72	DATA(16), I/O, TTL	100	MODULELOAD, OUTPUT, TTL

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Connectors on the digital boards

There is a digital video input connector on the digital cable adapter board and on the optional digital data input board (P/N: GEN-DIG-BRD/S). In addition, each digital board contains a digital interface connector (used to connect to the main board).



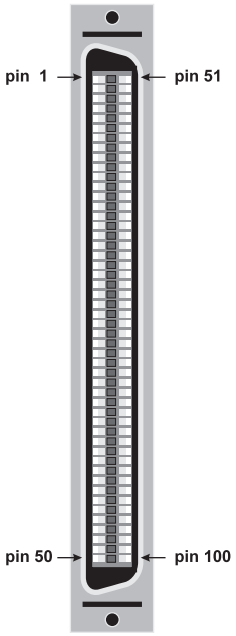
Digital video input connector on optional digital data input board

The digital video input connector on the optional digital data input board is a digital data input connector that connects to the DBDH100-TO-OPEN cable. The DBDH100-TO-OPEN cable (included with the digital data input board) allows you to build an interface cable from your video source to the digital data input board. If you to intend to completely build your own cable, or if you require additional cables, you can purchase the necessary components for the 100-pin, SCSI-2 type, DB-shell receptacle from A.R. Gray and Associates. Part numbers are:

- With shell and cable: HP-100C-20F-BO
- With shell only: CH-100MND011

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The following table provides the pinout of the digital data input board 100-pin receptacle:



PIN	SIGNAL	PIN	SIGNAL
1	DATA, INPUT, 0+	21	DATA, INPUT, 10+
2	DATA, INPUT, 0-	22	DATA, INPUT, 10-
3	DATA, INPUT, 1+	23	DATA, INPUT, 11+
4	DATA, INPUT, 1-	24	DATA, INPUT, 11-
5	DATA, INPUT, 2+	25	DATA, INPUT, 12+
6	DATA, INPUT, 2-	26	DATA, INPUT, 12-
7	DATA, INPUT, 3+	27	DATA, INPUT, 13+
8	DATA, INPUT, 3-	28	DATA, INPUT, 13-
9	DATA, INPUT, 4+	29	DATA, INPUT, 14+
10	DATA, INPUT, 4-	30	DATA, INPUT, 14-
11	DATA, INPUT, 5+	31	DATA, INPUT, 15+
12	DATA, INPUT, 5-	32	DATA, INPUT, 15-
13	DATA, INPUT, 6+	33	HSYNC, INPUT, +
14	DATA, INPUT, 6-	34	HSYNC, INPUT, -
15	DATA, INPUT, 7+	35	VSYNC, INPUT, +
16	DATA, INPUT, 7-	36	VSYNC, INPUT, -
17	DATA, INPUT, 8+	37	GROUND
18	DATA, INPUT, 8-	38	GROUND
19	DATA, INPUT, 9+	39	CLOCK, INPUT, +
20	DATA, INPUT, 9-	40	CLOCK, INPUT, -

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PIN	SIGNAL	PIN	SIGNAL
41	USER, INPUT, 0+	71	DATA, INPUT, 26+
42	USER, INPUT, 0-	72	DATA, INPUT, 26-
43	USER, INPUT, 1+	73	DATA, INPUT, 27+
44	USER, INPUT, 1-	74	DATA, INPUT, 27-
45	VALID, INPUT, +	75	DATA, INPUT, 28+
46	VALID, INPUT, -	76	DATA, INPUT, 28-
47	TRIGGER, INPUT, +	77	DATA, INPUT, 29+
48	TRIGGER, INPUT, -	78	DATA, INPUT, 29-
49	CAMERA CONTROL BIT0, OUTPUT, TTL	79	DATA, INPUT, 30+
50	GROUND	80	DATA, INPUT, 30-
51	DATA, INPUT, 16+	81	DATA, INPUT, 31+
52	DATA, INPUT, 16-	82	DATA, INPUT, 31-
53	DATA, INPUT, 17+	83	HSYNC, OUTPUT, +
54	DATA, INPUT, 17-	84	HSYNC, OUTPUT, -
55	DATA, INPUT, 18+	85	VSYNC, OUTPUT, +
56	DATA, INPUT, 18-	86	VSYNC, OUTPUT, -
57	DATA, INPUT, 19+	87	EXPOSURE1, OUTPUT, TTL
58	DATA, INPUT, 19-	88	EXPOSURE2, OUTPUT, TTL
59	DATA, INPUT, 20+	89	CLOCK, OUTPUT, +
60	DATA, INPUT, 20-	90	CLOCK, OUTPUT, -
61	DATA, INPUT, 21+	91	USER, OUTPUT, 0+
62	DATA, INPUT, 21-	92	USER, OUTPUT, 0-
63	DATA, INPUT, 22+	93	USER, OUTPUT, 1+
64	DATA, INPUT, 22-	94	USER, OUTPUT, 1-
65	DATA, INPUT, 23+	95	EXPOSURE1, OUTPUT, +
66	DATA, INPUT, 23-	96	EXPOSURE1, OUTPUT, -
67	DATA, INPUT, 24+	97	EXPOSURE2, OUTPUT, +
68	DATA, INPUT, 24-	98	EXPOSURE2, OUTPUT, -
69	DATA, INPUT, 25+	99	CAMERA CONTROL BIT1, OUTPUT, TTL
70	DATA, INPUT, 25-	100	CAMERA CONTROL BIT2, OUTPUT, TTL

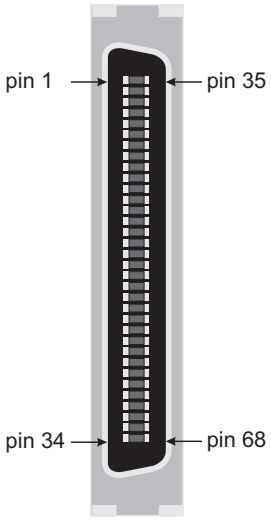
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Digital video input connector on digital cable adapter board

The digital video input connector on the digital cable adapter board is a digital data input connector that connects to the DBDH68-TO-OPEN cable. The DBDH68-TO-OPEN cable allows you to build an interface cable from your video source to the digital cable adapter board. If you to intend to completely build your own cable, or if you require additional cables, you can purchase the necessary components for the 68-pin, SCSI-2 type, DB-shell receptacle from DDK. Part numbers are:

- Cable assembly: DHA-A68-3G-HPA-O2S
- Metal cover: DHA-HPA68
- 68-positive plug: DHA-PA68-3G

The following table provides the pinout of the digital cable adapter board 68-pin receptacle:



PIN	SIGNAL	PIN	SIGNAL
1	NC	21	MODULE CLOCK, OUTPUT, TTL
2	EXPOSURE2, OUTPUT, 422+	22	GROUND
3	EXPOSURE1, OUTPUT, 422+	23	USER0, OUTPUT, TTL
4	USER1, OUTPUT, 422+	24	EXPOSURE1, OUTPUT, TTL
5	USER0, OUTPUT, 422+	25	GROUND
6	CLOCK, OUTPUT, 422+	26	VSYNC, OUTPUT, TTL
7	VSYNC, OUTPUT, 422+	27	NC
8	HSYNC, OUTPUT, 422+	28	GROUND
9	TRIGGER, INPUT, 422+	29	USER0, INPUT, TTL
10	VALID, INPUT, 422+	30	VALID, INPUT, TTL
11	USER1, INPUT, 422+	31	GROUND
12	USER0, INPUT, 422+	32	CSYNC, INPUT, TTL
13	CLOCK, INPUT, 422+	33	VSYNC, INPUT, TTL
14	CSYNC, INPUT, 422+	34	HSYNC, INPUT, TTL
15	VSYNC, INPUT, 422+	35	NC
16	HSYNC, INPUT, 422+	36	EXPOSURE2, OUTPUT, 422-
17	NC	37	EXPOSURE1, OUTPUT, 422-
18	NC	38	USER1, OUTPUT, 422-
19	GROUND	39	USER0, OUTPUT, 422-
20	NC	40	CLOCK, OUTPUT, 422-

❖ This table is continued on the next page ...

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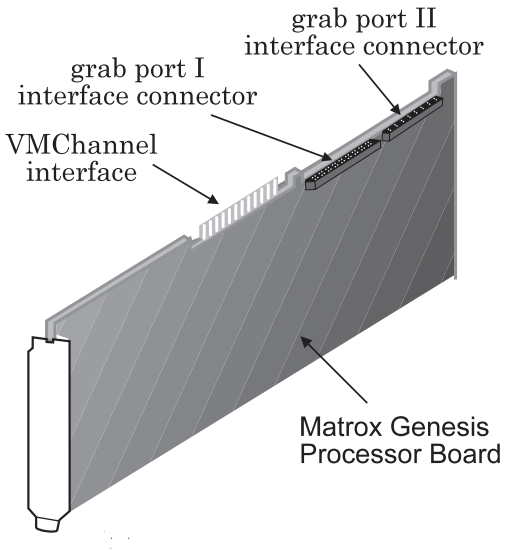
❖ ... This table is continued from the previous page.

PIN	SIGNAL	PIN	SIGNAL
41	VSYNC, OUTPUT, 422-	55	MODULE LOAD, OUTPUT, TTL
42	HSYNC, OUTPUT, 422-	56	MODULE DATA, OUTPUT, TTL
43	TRIGGER, INPUT, 422-	57	USER1, OUTPUT, TTL
44	VALID, INPUT, 422-	58	EXPOSURE2, OUTPUT, TTL
45	USER1, INPUT, 422-	59	CLOCK, OUTPUT, TTL
46	USER0, INPUT, 422-	60	GROUND
47	CLOCK, INPUT, 422-	61	NC
48	CSYNC, INPUT, 422-	62	HSYNC, OUTPUT, TTL
49	VSYNC, INPUT, 422-	63	USER1, INPUT, TTL
50	HSYNC, INPUT, 422-	64	GROUND
51	NC	65	CLOCK, INPUT, TTL
52	GROUND	66	GROUND
53	NC	67	TRIGGER, INPUT, TTL
54	NC	68	GROUND

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Connectors on the processor board

The processor board includes a VMChannel interface, the grab port I interface connector, and the grab port II interface connector.

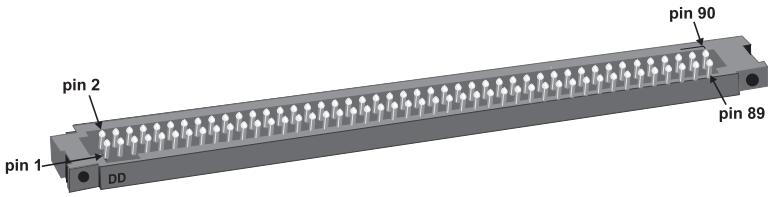


The VMChannel interface and the grab port II interface connector are identical to their counterparts on the main board (see previous sections for details).

The grab port I interface connector is similar to the grab port II interface connector except that it has 90 pins instead of 70. The pinout of the grab port I interface connector is shown on the following page.

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Grab port I interface connector



PIN	SIGNAL	PIN	SIGNAL
1	RESERVED	27	GP1D[6]
2	EBICLK2	28	GP1D[7]
3	DGND	29	DGND
4	DGND	30	DGND
5	RESERVED	31	GP1D[8]
6	RESERVED	32	GP1D[9]
7	RESERVED	33	GP1D[10]
8	RESERVED	34	GP1D[11]
9	DGND	35	DGND
10	DGND	36	DGND
11	DGND	37	GP1D[12]
12	RESERVED	38	GP1D[13]
13	RESERVED	39	GP1D[14]
14	RESERVED	40	GP1D[15]
15	RESERVED	41	DGND
16	RESERVED	42	DGND
17	DGND	43	GP1D[16]
18	DGND	44	GP1D[17]
19	GP1D[0]	45	GP1D[18]
20	GP1D[1]	46	GP1D[19]
21	GP1D[2]	47	DGND
22	GP1D[3]	48	DGND
23	DGND	49	GP1D[20]
24	DGND	50	GP1D[21]
25	GP1D[4]	51	DGND
26	GP1D[5]	52	DGND

❖ This table is continued on the next page ...

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❖ ... This table is continued from the previous page.

PIN	SIGNAL	PIN	SIGNAL
53	GP1D[22]	72	DGND
54	GP1D[23]	73	GP1VALID
55	GP1D[24]	74	RESERVED
56	GP1D[25]	75	GP1FIELD
57	DGND	76	RESERVED
58	DGND	77	DGND
59	GP1D[26]	78	DGND
60	GP1D[27]	79	GP1VSYNC
61	GP1D[28]	80	RESERVED
62	GP1D[29]	81	GP1HSYNC
63	GP1D[30]	82	RESERVED
64	GP1D[31]	83	DGND
65	DGND	84	DGND
66	DGND	85	DGND
67	RESERVED	86	DGND
68	RESERVED	87	GP1CLK
69	GP1SENSE	88	DGND
70	RESERVED	89	DGND
71	DGND	90	DGND

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Appendix C: Troubleshooting

This appendix suggests ways of solving problems you might experience while using Genesis.

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Troubleshooting

If you have problems using your Matrox Genesis, please try the following suggestions:

- Check for disconnected power cords or incorrect monitor connections.
- Read this chapter.

If your problem is not addressed here, or if these suggestions don't work for you, contact your local Matrox representative or the Matrox Imaging Customer Support Group.

Installation problems

☛ **After installing the MGA Windows NT 3.51/4.0 driver, my system does not reboot at the expected resolution.**

Make sure that you've selected a resolution and/or pixel depth combination that is supported by your monitor and by Matrox Genesis. To do this, start the **Display** applet from the **Control Panel**. Then, you can either:

- Click on the **List All Modes...** button to obtain a list of all the modes available for Matrox Genesis. Select a different mode from the displayed list. Click on the **OK** button to exit the current menu. Or,
- Use the **Color Palette** (for pixel depth) and **Desktop Area** (for resolution) controls from the **Display Settings** dialog box.

Use the **Test** button to ensure that your monitor supports the new mode. You will have to reboot your system for the new settings to take effect.

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☛ **After installing the MGA Windows NT 3.51/4.0 driver, my display is unstable at the resolution I chose. Now, I cannot access the Control Panel to choose a different resolution.**

Reboot your system, and select the regular VGA mode. Then, make the required changes.

Alternatively, reboot your system, choose the regular VGA mode, and press the spacebar when the "Last Known Good Menu" message appears. Select the "Last Known Good Configuration" option from the resulting menu. Then, make the necessary changes.

Booting problems

☛ **My computer beeps, hangs shortly after booting, or will not boot when I turn on the power.**

There are many possible causes for such a problem. Most are temporary and require quite simple solutions. Check the following:

- Remove any non-compatible display adapters (such as an EGA or VGA) from your system, and ensure that the VGA on the motherboard is disabled.

Register conflicts

- Check for a register (input/output) conflict. Conflicts are rare since Matrox Genesis display section registers reside in the standard VGA register space and occupy another fully configurable memory space that the system can change during bootup.

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System incompatibility

☛ **While performing specific operations (for example, grabbing), my Genesis board stalls.**

Some operations (for example, grab operations) make use of the interrupt line assigned to the PCI slot where the Genesis board is installed. These operations might freeze or not function properly for the following reasons:

- There is no interrupt line assigned to the PCI slot where the board is installed;
- The interrupt line used by the board is shared by the PCI bus and another bus (ISA or EISA);
- The interrupt line used by the board is shared with another PCI device (e.g. network board, SCSI board, etc.).

Make sure that an interrupt line (IRQ) has been assigned to the PCI slot of your Matrox Genesis board. To do this, check your system setup or use one of the external utilities that came with your PC. Your computer manual might also be of help.

❖ Note that PCI devices cannot share common interrupt lines with EISA or ISA devices. However, PCI devices can share an interrupt line.

Network-related interrupt conflicts

In systems that use Windows network configurations, there might be a conflict between the interrupt lines used by Matrox Genesis when grabbing and the interrupt lines used by Windows when accessing the network. In such cases, try the following suggestions:

- Make sure your BIOS configuration has assigned an interrupt line to the PCI slot that is used by the board. To do this, check your system's setup or use one of the external utilities that came with your PC.

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Shareable interrupt lines

- With the PCI bus, interrupt lines are shareable among PCI devices. However, the PCI bus must not use any interrupt lines that are also used by the ISA or EISA bus.

  If you cannot assign an interrupt line that will be used exclusively by Matrox Genesis, try to assign an interrupt line that Matrox Genesis can share with another PCI device. If problems still occur, try sharing a different interrupt line.

Insufficient bandwidth

Some currently available PCI bus systems do not offer sufficient bandwidth for full-transfer capability to Host memory with Matrox Genesis.

BIOS software limitations

Some currently available PCI systems do not recognize PCI-to-PCI bridges due to limitations in their BIOS software. Consequently, the system may not boot since it cannot correctly initialize the PCI devices on the Genesis board.

Video display problems

Blank screen

☛ **My monitor is blank (or it has shades or spots of gray and white).**

- Ensure that Matrox Genesis is fully inserted into its slot and is evenly seated. To do this, press the board down firmly.
- Recheck your connections at both ends of the video cable.
- Check that the system is plugged in and make sure your computer and monitor are turned on.
- Check that the brightness and contrast controls are set correctly.
- Set the monitor's switches (if any) to 75 ohms for the video (RGB) inputs, and set the synchronization to 'external' (and to high-impedance if this option is available). If there is a Digital/Analog switch on your monitor, set it to 'Analog'.

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- There might be a memory or register conflict (see "Your computer beeps, hangs shortly after booting, or will not boot when you turn on the power", discussed under the *Booting problems* section of this appendix). Consult the documentation for all other boards (EISA or ISA) in your system and check that they are not located in the address or register space used by Matrox Genesis.

Colors

☛ **The colors are wrong.**

Incorrect colors indicate that either the cabling (for monitors that don't have a built-in cable) or the monitor impedance is incorrect.

- Ensure that the red, green, and blue lines are connected to the corresponding red, green, and blue monitor inputs (some monitor input connectors are not in the expected order).
- Make sure your monitor's RGB inputs are set to 75 ohms. Several monitors have individual switches to set the impedance of the inputs. Make sure that they are all set to 75 ohms.
- On some PCs, you must run a setup program or set DIP switches to select the main video adapter type. For most PCs, you should select an EGA/VGA type. Refer to the user manual for your computer.
- Check the cable continuity. Replace the cable with a different cable and check whether the problem persists. If it doesn't, the cable was defective.

☛ **The display is not centered.**

Adjust the centering control of your monitor to position the picture on the screen (refer to your monitor's manual).

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☛ **The picture quality is poor, with a dim picture, poor contrast, and poor sharpness.**

The monitor might be improperly adjusted.

- Adjust the brightness, sharpness, and contrast controls of your monitor.
- Ensure that the cable is correctly and completely inserted at both ends.
- Make sure that the RGB input switches are set to 75 ohms.

☛ **The picture is broken up, with bad horizontal sync; in other words, it rolls, jitters, or blinks.**

The monitor's connections might be incomplete (that is, the cables connected to the monitor might not be attached properly), the monitor might be misadjusted, or the monitor might not accept the video parameters of the Genesis.

- Ensure that the synchronization line(s) are properly connected to your monitor (to identify the sync line(s), refer to the appropriate monitor configuration in the *Connecting to a monitor* section of Chapter 2). If this does not solve the problem, your monitor might need horizontal setting adjustments, or it might be defective. Refer to your monitor's manual.
- Ensure that the resolution you specified is valid for your monitor.

Problems running DOS programs

☛ **I cannot run DOS programs in Super VGA modes.**

The on-board VGA of the Genesis is completely compatible with programs that use standard VGA and VESA modes. It is also compatible with Super VGA modes. However, if you experience problems running DOS programs in Super VGA modes, ensure that the program is compliant with version 1.2 of the VESA Super VGA standard. Some programs that are written to run in Super VGA modes are not VESA-compliant, and depend on the specific chip used for the VGA. They are probably not compatible with the VGA extended modes of the Genesis.

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Problems during application development

- **I want to overlay VGA data on main (image) frame buffer data.**

  Use the *imDispControl()* command, or the GENKEY utility (see Chapter 3 for more information on this utility), to set the Matrox Genesis video keyer. The video keyer compares each pixel coming from the VGA to the reference color and, based on the result, routes either the VGA or the main frame buffer pixel to the display.

- **I'm running an application and the system 'hangs' or produces unwanted results.**

  Check for an interrupt, memory or register conflict. Sometimes, an EISA or ISA device might attempt to use the same interrupts, register or memory space as Matrox Genesis, and this causes a conflict.

- **When I run an application, there is no picture on my video display. The monitor is blank.**

  The application you are running might be attempting to select a resolution that isn't supported by your monitor. Check your monitor's manual for supported resolutions.

Contacting Matrox

What you'll need if you call Matrox

Before contacting your local Matrox representative or the Matrox Imaging Customer Support Group, you will need the following information:

- A description of what happened.
- Your board's serial number (printed on the solder side of the board).
- System type, environment, and peripherals (especially boards sharing the computer with your Matrox Genesis).

A Product Assistance Request form for recording the necessary information can be found at the back of this manual.

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Customer support

You will find up-to-the-minute release information on our web site:

http://www.matrox.com/imaging

Refer to the *Customer support contacts* information sheet included with your package for the current phone numbers of Matrox's regional offices.

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Warranty

This product is warranted against defects in materials and workmanship for a period of ***one year*** *from date of delivery. We will repair or replace products that prove to be defective during the warranty period provided they are returned, at the user's expense, to Matrox Electronic Systems Limited. No other warranty is expressed or implied. Matrox is not liable for consequential damages.*

If you wish to return your board, contact the Matrox authorized dealer where you purchased the board for service. **Do not return a product to Matrox without authorization.**

If for some reason you must return the board directly to Matrox, follow these steps:

1. Contact Customer Support (the *Customer support contacts* information sheet included in your package has the phone numbers for Matrox's offices).

   Customer Support will ask you to describe the problem and will issue a Return Merchandise Authorization (RMA) number, if necessary.

2. Leave the configuration as it was when you were using the board.

3. Pack the board in its original box and return it with a completed "Product Assistance Request" form (see the following page).

Return address

U.S. customers must return their products to our U.S. address:

- Matrox International Corp.
  625 Route 3 Unit B
  Plattsburg, N.Y.
  12901-6530

Canadian and other international customers can return their products directly to our Canadian facility:

- Matrox Electronic Systems Ltd.
  1055 St. Regis Blvd.
  Dorval, Quebec
  H9P 2T4

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Product Assistance Request Form

Name:	
Company:	
Address:	
Phone:	Fax:
E-mail:	
Hardware Specific Information	
Computer:	CPU:
System memory:	PCI Chipset:
System BIOS rev:	
Video card used:	Resolution:
Network Card:	Network Software:
Other cards in system:	
Software Specific Information	
Operating system:	Rev:
Matrox SW used:	Rev:
Compiler:	Rev:
Fill out only if you are returning a board	
RMA #:	
Who were you talking to in customer support?	
Date board was received:	Date of failure:
MOD #:	These numbers are on the label at the back of the board.
SER #:	
REV #:	
PMB #:	
PNS #:	
Can you reproduce the problem? Yes ❒ No ❒	
Is an error code displayed? Yes ❒ No ❒	If so, what code?
	... Continued on reverse

Describe the problem:

Regulatory Compliance

FCC Compliance Statement

Warning

Changes or modifications to this unit not expressly approved by the party responsible for the compliance could void the user's authority to operate this equipment.

Note

This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and

2. this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this device in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense. The user is advised that any equipment changes or modifications not expressly approved by the party responsible for compliance would void the compliance to FCC regulations and therefore, the user's authority to operate the equipment.

Industry Canada Compliance Statement

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulations of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de Classe A prescrites dans le Règlement sur le brouillage radioélectrique édicté par Industrie Canada.

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EC Declaration of Conformity

WARNING: This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures

AVERTISSEMENT: Cet appareil est de la classe A. Lorsque cet appareil est utilisé dans un environnment résidentiel, il peut entraîner des interférences radioélectriques. Dans ce cas, l'usager peut être prié de prendre des mesures correctives appropriées.

This device complies with EC Directive 89/336/EEC for a Class A digital device. It has been tested and found to comply with EN55022/CISPR22 and EN55024/CISPR24.

Le présent appareil numérique répond aux exigences stipulées dans la directive européenne 89/336/EEC prescrite pour les appareils numériques de classe A. Ce produit a été testé conformément aux procédures EN55022/CISPR22 et EN55024/CISPR24.

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