

ELSA GLADIAC™ MX

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Preface

Thank you for placing your trust in this ELSA product.

In choosing the *ELSA GLADIAC MX*, you have selected a graphics board which is just as well suited to professional users as to ambitious players. ELSA products are subject to the highest of standards in production and quality control which are the foundation for consistently high product quality.

This manual provides all the information you will need to get the best out of your ELSA graphics board. For instance, which resolution is best for which monitor, or how is the board upgraded? The accompanying utility programs are described, and you will find detailed information about 3D acceleration.

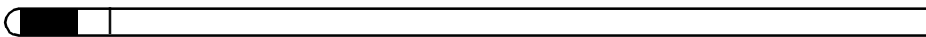
Further information on the Internet at 'www.elsa.com'

Our online services 'www.elsa.com' are available to you around the clock should you have any queries regarding your *ELSA GLADIAC MX* or require any further support.

Our KnowledgeBase can be found at 'www.elsa.com/support'. In the 'Support' file section under 'Know-How', you can find answers to frequently asked questions (FAQs). Current drivers, firmware, tools and manuals can be downloaded at any time.

The KnowledgeBase can also be found on the CD.

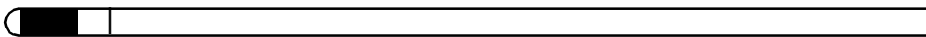


***Before you read on...***

The installation of the ELSA GLADIAC MX hardware and software drivers is described in full in the Installation Guide which accompanies this manual. You should refer to that document before attempting to install your board, and before reading this manual.

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1

Introduction

"Reading the manual is a waste of time." A prejudice you are proving to be wrong right now by reading this manual. And rightly so. In this case, it is really worth the effort. Because the *ELSA GLADIAC MX* has some smart features that are only described here in the manual.

So only those who read the manual will truly be taken with this card. We'll make it as short and easy as we can, promise.

1.1

Highlights of the *ELSA GLADIAC MX*

- The latest 3D graphics technology with the NVIDIA GeForce2 MX processor
- 32-MB SDRAM give you scope for image processing and huge textures
- 2 HyperTexel pipelines and per-pixel shading for even greater realism
- High-definition picture—high performance with up to 2048x1536 pixels, over 16million colors and refresh rates of 200Hz provide an astounding picture—ideal for 19" to 24" monitors
- ELSA SmartRefresh and ELSA SmartResolution ensure optimized monitor use by providing the ability to modify resolution and refresh rate separately
- Support via Internet and hotline
- CE and FCC conformity
- Six-years warranty

1.2

What's in the box?

You will notice if your graphics board is missing. But you need to check that the box contains all of the following:

- Graphics board
- Installation Guide
- CD-ROM with installation and driver software and utilities

If any part is missing please contact your dealer. ELSA reserves the right to vary the products supplied without prior notice. The current scope of delivery is described on our web site.

1.3

What hardware do I need?

- **Computer:** A system with a Celeron, Pentium II or AMD K6-2 processor (300 MHz or higher) and a minimum of 32 MB RAM is required. Approx. 100 MB free disk space and a CD-ROM drive are required for the installation.
- **Bus:** The *GLADIAC MX* is available as an AGP version. Your computer must have a free AGP slot, and must support the AGP standard as specified in version 1.1 or higher.
- **Monitor:** The *GLADIAC MX* works with the standard IBM VGA compatible horizontal scan frequency of 31.5kHz while booting and in DOS operation.

2

After installing the drivers

In this chapter you will find descriptions of

- where you can find the software for operating your ELSA graphics board,
- the performance characteristics of your graphics board, and
- the most effective tuning for the combination of monitor and ELSA graphics board.

2.1

Software installation from the CD



The ELSA graphics board is normally supplied with software on a CD-ROM. You will find all the utilities described in this manual on the GLADIAC MX CD—unless they are a component of the operating system.

Once you have successfully completed the steps described in the Installation Guide, your ELSA is integrated into your computer system with installed drivers. You are now likely to be familiar with the program ELSA setup. If the autostart function for your CD-ROM drive under Windows has been switched off, the setup program on the *GLADIAC MX* CD will not start automatically. It can be found and started manually from the root directory of the CD and is called SETUP.EXE.

The greater part of the installation is automated; ELSA setup detects the installed operating system and ELSA graphics board(s). First of all select the language for the installation and then the components you wish to install.

2.2

The right settings

Our tip is: invest a little time at this stage and you won't regret it. Take your time to set up your system just right. Your eyes will thank you for it, and you are guaranteed to have more fun in front of your screen.

To set up your system properly, the following questions should be answered:

- What is the maximum resolution I can set on my system?
- Which color depth do I want to use?
- How high should the refresh rate be set?

To help you find the answers to these questions, this chapter has been divided according to the operating systems available. Just look for the section about the operating system you use. All you need to know you will

find there. All the software you need, if not already a part of your operating system, is on the *GLADIAC MXCD*.

2.2.1

What are your options?

The tables below show the maximum possible resolutions for the ELSA graphics board. Note that these resolutions cannot be achieved under all operating conditions.

Color depth	Max. refresh rate (Hz)		
	256 colors (8 bit)	HighColor (16 bit)	TrueColor (32 bit)
2048 x 1536	60 – 75	60 – 75	60 – 75
1900 x 1440	60 – 85	60 – 85	60 – 85
1600 x 1200	60 – 120	60 – 120	60 – 100
1280 x 1024	60 – 170	60 – 170	60 – 150
1024 x 768	60 – 200	60 – 200	60 – 200
800 x 600	60 – 200	60 – 200	60 – 200
640 x 480	60 – 200	60 – 200	60 – 200

HighColor = 65,536 colors, TrueColor = 16.7 million colors

2.2.2

What is best for what situation?

There are some basic ground rules for you to follow when setting up your graphics system. On the one hand, there are the ergonomic guidelines, although nowadays these are met by most systems, and on the other hand there are limitations inherent to your system, e.g. your monitor. The question of whether your applications need to run using large color depths—perhaps even TrueColor—is also important. This is an important condition for many DTP or CAD workstations.

“More pixels, more fun”

This is an opinion which is widespread, but which is not entirely true under all circumstances. The general rule is that a refresh rate of 85Hz meets the minimum ergonomic requirements. The resolution to be selected also

depends on the capabilities of your monitor. The table below is a guide to the resolutions you might select:

Monitor size	Typical image size	Minimum resolution	Maximum resolution	Ergonomic resolution
17"	15,5"–16,0"	800 x 600	1024 x 768	1024 x 768
19"	17,5"–18,1"	1024 x 768	1280 x 1024	1152 x 864
20"/21"	19,0"–20,0"	1024 x 768	1600 x 1200	1280 x 1024
24"	21,0"–22,0"	1600 x 1000	1920 x 1200	1600 x 1000

2.3 Changing the resolution

You set the resolution of your graphics board in the Control Panel under Windows.

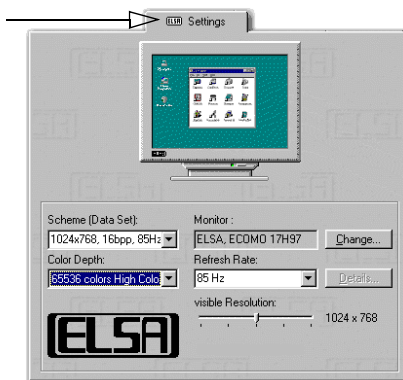
2.3.1 Settings for Windows 95 and Windows 98

Under Windows 95 and Windows 98, '**ELSA** Settings' pertaining to the installation of the *WINman Suite* are integrated into the 'Display' dialog of the Control Panel. This ensures the most effective tuning for the combination of monitor and graphics board.

The '**ELSA** Settings' provide some great features. Once you have specified the graphics board model and the monitor data, the program will automatically detect which settings are possible and which are not. This means, for instance, that it is impossible for you to select an incorrect refresh rate which might damage your monitor.

- ① Click on **Start**, then select **Settings ► Control Panel**.
- ② You will find the **Display** icon in the Control Panel. When you start this program, you are shown a dialog box where you can modify the display settings.
- ③ Click here on the '**ELSA** Settings' tab.

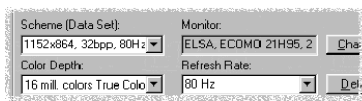
The **ELSA** 'Settings' tab has all the options for setting up the graphics board for your monitor.



*Under Windows 98 the 'ELSA' Settings' can be accessed by selecting the 'Settings' tab and clicking the **More Options...** button.*

It is important to carry out the following settings or checks step by step:

- the monitor type
- the resolution of the monitor image (scheme, data set)
- the color depth, and
- the refresh rate.



Choosing the monitor

If your monitor supports DDC, the preset values will be displayed under 'Scheme' with Windows 95 and Windows 98.

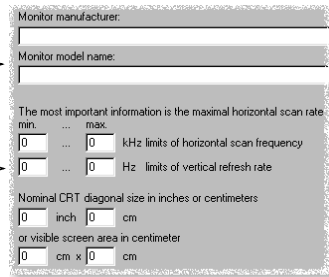
If this is not the case, click on **Change...** to call up the database of monitor types. You will be presented with a list of monitor manufacturers and monitor models. If your manufacturer is present, click on the entry and then select your model. If your monitor is not listed, there are two options. One option is to select the '_Standard monitor' from the list of manufacturers and then select the highest permitted resolution. If you are not sure, select a lower resolution to be safe.

A second option requires information about the technical specifications for your monitor. Consult your monitor manual to ensure that you have the correct information. Click on **Change...** in the 'Monitor type database' window. In addition to the information regarding the monitor manufacturer,

and the model designation, you will have to enter the frequency ranges for the horizontal and vertical scan frequencies and specify the diagonal size of your monitor.

If your monitor type is not listed in the monitors database you can enter the monitor manufacturer and model type here.

The vertical and horizontal frequency ranges and the diagonal size of the screen are the important settings.




Check your entries for the image frequencies carefully, as otherwise you might damage your monitor. Look these up in your monitor manual or consult the monitor manufacturer.

After you have registered and installed the monitor under Windows, you can set the desired color depth, the optimum resolution and an ergonomic refresh rate.

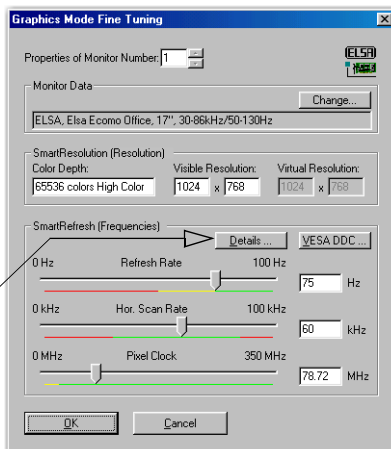
ELSA SmartRefresh and ELSA SmartResolution

Click the **ELSA Details** button in the 'Settings' to open a dialog where you can adjust the refresh rates and video timings individually. In addition you can change the resolution in steps of 32 pixels. The graphics mode fine-tuning tool is especially for screens in portrait or wide-angle format, or with the 4:3 aspect ratio. In such cases it is clearly advantageous to have the option of freely-selectable values.

SmartResolution: Allows you to adjust the resolution in steps of 32 pixels.

SmartRefresh: Allows you to accurately adjust the refresh rate.

Note: The settings for the monitor timings should only be changed by specialists.



2.3.2

Windows 2000

The settings for the graphics driver are included in the Control Panel under Windows 2000. Use the command sequence

Start ► Settings ► Control Panel

to call the dialog window where you should find the icon for **Display**. Double click on this symbol to open the window with its various tabs.

- ① Click on the 'Settings' tab.
- ② Click **Advanced...** in the 'Settings' dialog.
- ③ Select the 'Graphics Board' tab in the dialog that opens.
- ④ A button labeled **Display Mode...** is located in the lower part of the window. Click it to view a list of all configurable combinations of resolution, color depth and refresh rate. The values in the list depend on the capabilities of the monitor and graphics board. Select the desired combination and confirm by pressing **OK**.
- ⑤ When finished, click **Apply...** to check the new settings. You are then given the option of selecting or canceling the chosen settings. If you are satisfied with the new combination, confirm your selection by pressing **OK**.

If using Windows 2000, you will have to reboot your system.



2.3.3

You will find further information on how to customize your graphics settings under Windows 2000 in your system manual.

Windows NT 4.0

The settings for the graphics driver are included in the Control Panel under Windows NT 4.0. Use the command sequence

Start ► Settings ► Control Panel

to call the dialog window where you should find the icon for **Display**. Double click on this symbol to open the window with its various tabs. Click on the 'Settings' tab.

You can select the possible settings for 'Color palette', 'Font size', 'Resolution' and 'Display frequency' from this dialog box. The available selection is determined by the ELSA driver you have installed. You should always check the configuration you have selected by clicking on the **Test** button.



You will find further information on how to customize your graphics settings under Windows NT 4.0 in your system manual.

3

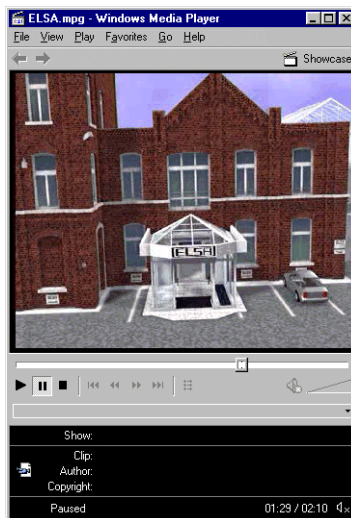
Useful stuff and more

Apart from the ELSA drivers, the ELSA CD also contains additional programs and utilities for use with the *ELSA GLADIAC MX*, a selection of which we will introduce here. Information about other programs can be taken from the README files on the CD.

3.1

The Multimedia Player

Until now, a variety of programs for playing CDs, videos and other media was available under Multimedia in the Accessories folder of the Windows start menu. These have now been succeeded by the Microsoft Multimedia Player. It handles the most common multimedia formats, all under one common user interface. Regardless of whether the data is coming from the Internet or the local hard disk: The Multimedia Player is responsible for the playback of RealAudio and RealVideo, as well as WAV, AVI and Quicktime files.



Video playback or Internet live radio: The Microsoft Multimedia Player handles all common multimedia formats.



After the installation, the file extensions of media files are permanently associated with the Multimedia Player. You can thus double-click the media files in the Windows Explorer or My Computer folder to conveniently launch the Player and start the playback.



The use of the Multimedia Player is intuitive, and it includes a comprehensive help function to clarify questions or solve problems while working with the program.

3.2

ELSA WINman Suite

Installing the ELSA drivers also places the *WINman Suite* in the Windows taskbar. *WINman Suite* provides you with quick access to all ELSA tools, letting you bypass the indirect route to the tools through the Control Panel.



This program is loaded automatically at system startup. If you do not want the *WINman Suite* to load at startup, you can disable this option in the *WINman Suite* menu.

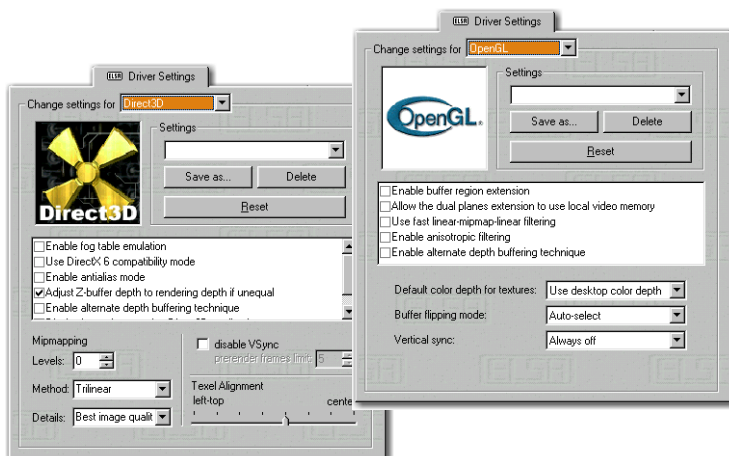
If you want to load the program later, you can call it up by selecting

Start ► Programs ► ELSAware ► WINman Suite.

3.3

Fine-tuning for performance freaks

After installing the ELSA graphics drivers under Windows 95, Windows 98, and Windows 2000 you will find a new tab in the 'Display Properties': The '**ELSA** 3D Settings'



Because Windows 98 and Windows 2000 allow the operation of multiple graphics boards, the 3D settings for the GLADIAC MX are to be found in

another location. Under 'Display Properties' select in turn: 'Settings' ► **Advanced...** ► **ELSA 3D Settings**:

These settings let you set up the optimal games performance on your system. In most cases you don't need to adjust anything. In some cases, for example if you see display errors on screen or if there are problems with the speed, you can adjust the driver settings. The settings which are optimal for any game can be saved under an identifiable name and quickly recalled without having to restart your system.

Experimentation pays! Give your combatant a little extra "zip" and optimize his chances against the competition. If the descriptions here are too cryptic, just take a look at the glossary in this manual or use the comprehensive help system. Simply click on the question mark at the top right-hand corner of the dialog window, and then click on the item in question. If you accidentally dump your system into the crawler-lane, just click on the emergency button **Restore Defaults**. The standard settings will be called into action.



The question mark provides the answers! If you want more information about any setting, just click on this symbol and then select the area in the dialog about which you want to know more.



3.4

Adjusting the anti-aliasing

The anti-aliasing function and the degree of its effect can be adjusted for games and applications using Direct3D.

With anti-aliasing disabled, the edges of objects frequently look jagged. Anti-aliasing provides a clever smoothing effect for these edges for a more realistic display.

It does impair the speed of the display, however. Display quality and performance can be



balanced by changing the level of anti-aliasing to suit your personal preferences under '**ELSA** Driver Settings'.

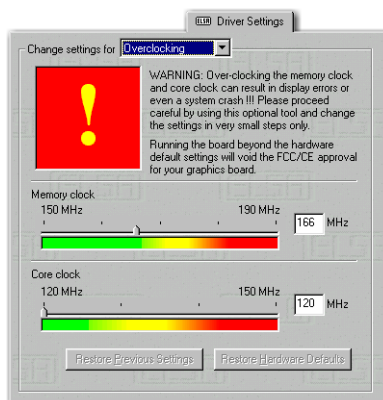
Move the slider toward **Minimum** for a faster display, and toward **Maximum** to improve the smoothing of the edges.

3.5 Overclocking

The overclocking tool enables you to increase the values for memory clock and core clock in order to push the performance of the graphics board.

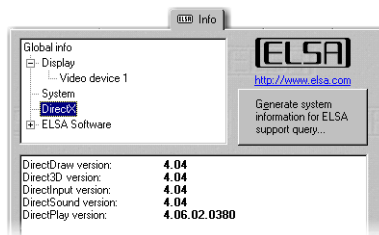
If you like to increase these values please be careful! In any case you should do it in little steps (1 MHz). Changing the settings becomes active when you click the button **Accept**.

The first sign when putting great strain on the graphics board are pixel errors, which you can easily notice on your monitor.



3.6 ELSA Info

Use ELSA Info to investigate your system. In addition to the details about your graphics board you will find information about your computer system, the DirectX and OpenGL driver versions and the ELSA software you have installed. This information provides a basis for generating a report that can be of use in case you require support. This collection of information provides the ELSA Support with all the information they need to guarantee you fast and relevant help.



4

Graphics know-how

This is the chapter where we really get stuck in. Anyone who wants to know more about graphics—especially in connection with the *ELSA GLADIAC MX*—will find a whole load of technical stuff right here.

4.1

3D graphics representation

Today it is considered de rigueur to know all about 3D. Your curiosity will be aroused as soon as you experience the first visual wizardry generated by your new graphics board. Two features of the 3D display will leap out at you: it's both realistic and fast. The amount of work required here is known only to the processor, but we will describe it in detail to you below.

4.1.1

The 3D pipeline

What actually happens when a monitor displays a 3D object? The data describing the 3D object are passed through what is known as the 3D pipeline, in which the mathematical calculations for its representation in space and perspective on the monitor are carried out. What happens in detail?



Start: The object data

The pipeline starts at the object. The object description is made up of the data (points). The basic geometric primitive is the triangle. The corner points of the object's triangles are described using coordinate points (x, y and z), where the 'z' value represents the depth information. Depending on the display representation, these points are assigned additional data regarding material, texture, special effects and much more. As a result, an enormous amount of data is sent into the pipeline.

Geometrical transformation

This part of the 3D pipeline is very processor-intensive, as all the calculations for the 3D scene are carried out at this stage. Simplified, it comprises the following steps:

- **Transformation**—In transformation, the objects are aligned in perspective as seen from the observer's point of view.
- **3D clipping**—In this process, each polygon is checked to determine whether it is partially or fully invisible. The invisible faces or parts of objects will be removed.
- **Back-face culling**—This process computes hidden surfaces resulting from the observation perspective chosen. Any object having an invisible front surface is omitted.
- **Illumination**—The illumination of the scene by different light sources is calculated.
- **Scaling on the screen**—The above steps are now calculated for three-dimensional space using normalized coordinates. The on-screen image coordinates will only now be computed.

Rendering

At this stage, the 3D scene is filled with color shades and textures are applied. Different processes and methods are also applied here.

- **Shading**—Shading takes account of the effects created by different light sources on the 3D object and provide for a very realistic overall impression. Here, too, there are different methods which are more or less processor-intensive:
 - Flat shading assigns a color value to each polygon. This results in a faceted representation, which requires only short computation times.
 - In Gouraud shading, all the vertices of the polygons are assigned a color value. The remaining pixel information for the polygon is interpolated. This method gives a very gentle color transition, even with fewer polygons than are required for flat shading.
- **Texture mapping**—At this stage, the 3D object undergoes a sort of “face lift”. The materials and textures are assigned. Different methods are used here to make the textures appear realistic, even when enlarged or reduced. As a first step, the textures are computed:
 - Point sampling is the simplest method. A pixel-by-pixel comparison is made between the texture template and the surface to be filled. This method leads to a very coarse representation, especially when enlarged.
 - In linear mapping, a new color value is interpolated from the adjacent pixels (or texels) of a texture. This gives better results than point sampling, as the hard boundary between the coarse pixels is blurred.

- The MIP mapping method stores a large number of enlargement stages for the texture. The depth information of a primitive is then used to determine which enlargement stages of the texture will be used in drawing. Information concerning the transparency of the texture is carried in the alpha channel. Finally, a distinction is made in MIP mapping between bilinear and trilinear filtering. Bilinear filtering interpolates between two pixels of two textures, trilinear filtering interpolates between four pixels for each of two textures.
- Bump mapping introduces a new dimension. Relief or raised textures can only be generated with the other methods in two dimensions using light and shadow effects.

The staircase effect is corrected by anti-aliasing. This is either done by interpolating mixed pixels, in which a new color value is computed from two adjacent color values, or by using transparent pixels of the same color which are overlaid over adjacent pixels.

● The frame buffer

The finished image will not be written to the frame buffer until this complex sequence of steps is completed. The frame buffer is made up of front and back buffer. The back buffer acts as a buffer page, in which the next image to be displayed is built up. The front buffer is the memory area where the image that appears on the monitor is located. This prevents the process of image drawing being visible. The duplicate storage method is also known as double buffering.

Buffer swapping Display on the monitor

Two possibilities exist for transferring a completed image from the back to the front buffer, and thus to the display. The obvious method is to copy the contents to the front buffer one byte at a time, a process known as “blitting”. Page flipping is significantly faster: in this case the content of the buffer is not rewritten—the addresses of the front and back buffers are simply exchanged. As a result, only tiny data volumes are transferred.

The buffer swapping will only ever be performed once the image drawing process in the back buffer is completed. This procedure should be repeated at least 20 times a second to give a smooth representation of 3D scenarios. In this context, we speak of frames per second (fps). This is a very important value especially for 3D applications. A cinema film runs at 24fps.

4.2

3D interfaces

Software interfaces, including 3D interfaces, are known as APIs (Application Programming Interface). The question is what these interfaces are used for and how they work.

In simple terms: They make developers' work easier. In the past it was necessary to address the various hardware components directly in programming if you wanted to exploit their capabilities to the full. The APIs are a kind of translator operating between the hardware and the software.

The specification of standard definitions was the precondition for the proper function of these translation routines. These definitions are implemented by the hardware manufacturers during development and optimized for the hardware concerned. Developers can implement complex procedures relatively easily by using these definitions. They can use a uniform command set when programming and do not need to know the characteristics specific to the hardware.

4.2.1

What APIs are available?

There are a good dozen more or less commonly found 3D APIs. However, in recent years, two formats have established themselves as the favorites: Direct 3D and OpenGL. ELSA graphics boards support these commonly found 3D interfaces. The functional differences between the interfaces are slight. Your *ELSA GLADIAC MX* supports the following APIs.

4.2.2

Direct 3D

As a development of Mode X and DirectDraw under Windows 3.1x, Direct 3D is a branch of the DirectX multimedia family which was developed directly for Windows 95 to accelerate the slow 3D display characteristics of the operating system. Direct 3D cooperates with Direct Draw in two-dimensional display. A typical situation would be, for instance, rendering a 3D object while Direct Draw is placing a two-dimensional background bitmap.

Immediate mode and retained mode

As can be assumed from the two terms, immediate mode is a programming mode that is close to the hardware. Retained mode, on the other hand, is a programming mode that is largely predefined through an API interface. What does this mean in detail? Looking at the two systems hierarchically, the immediate mode is also known as the low-level mode. The programming

interface level is close to the hardware level and permits the programmer direct access to special functions in the hardware component concerned. The retained mode (high-level mode) makes it possible, for example, to load a defined 3D object with textures into a Windows application. Here it can be manipulated and moved using simple API commands. Translation takes place in real time, without the need to know the technical structure of the object.

For further information see the Internet site www.microsoft.com/directx.



4.2.3

OpenGL

Following its success in gaining a good reputation amongst professionals using CAD/CAM programs, OpenGL is now increasingly penetrating the PC market. OpenGL is platform-independent and makes a distinction between immediate and display list modes. A display list stores specific sequences that can be recalled again later. The object descriptions can then be taken directly from the list, resulting in very high performance. However, if objects need to be manipulated frequently, the display list will have to be generated again from new. OpenGL provides a wide range of graphics features, from rendering a simple geometric point, line, or filled polygon, to the most sophisticated representations of curved surfaces with lighting and texture mapping. The some 330 routines of OpenGL provide software developers access to these graphics capabilities:

For further information see the Internet site www.sgi.com/software/opengl.



4.2.4

Color palettes, TrueColor and gray scales

Common graphics modes are listed in the following table. Not all graphics modes are available on the ELSA

Graphics mode	Colors			
	bpp	bpg	(from palette)	Max. gray levels
VGA 0x12	4	6+6+6	16 of 262,144	16
VGA 0x13	8	6+6+6	256 of 262,144	64
Standard	8	6+6+6	256 of 262,144	64
	8	6+6+6	256 of 16.7 million	256
HighColor	15	5+5+5	32,768	32
	16	6+6+4	65,536	16
	16	5+6+5	65,536	32
TrueColor	24	8+8+8	16.7 million	256
	32	8+8+8+8	16.7 million	256

(bpp = bits per pixel; bpg = bits per gun)

4.2.5

VGA

In VGA graphics boards, the digital color information stored in the video memory (4 bits for 16 colors or 8 bits for 256 colors) is converted into a digital 18-bit value in the graphics adapter in a CLUT (ColorLookUpTable). The 3 x 6 bits are converted separately for R/G/B (red/green/blue) in the RAMDAC (D/A converter) and transferred to the monitor as analog signals on just three lines (plus sync lines). The original color values are converted into completely different values by means of a translation table. The value stored in the video memory is thus not a color value, but only a pointer to a table in which the actual color value is found. The advantage of this method: Only 8 bits need to be stored for each pixel, although the color values are 18 bits wide; the disadvantage: Only 256 colors can be displayed simultaneously from a palette of 262,144 possible colors.

4.2.6

DirectColor

The situation is different in the case of DirectColor (TrueColor, RealColor and HighColor). In this case, the value stored in the video memory is not translated but is passed directly to the D/A converter. This means that the

full color information must be saved for each pixel. The meanings of the terms RealColor, TrueColor, and HighColor can be confused, as they are not always used unambiguously.

HighColor and RealColor

HighColor and RealColor usually describe a 15 or 16-bit wide graphics mode, while TrueColor should only be used for the more professional 24-bit mode (or 32-bit) mode.

15 bits provide 5 bits each for the red, green and blue values, resulting in 32 levels per RGB component and thus 32,768 (= 32 x 32 x 32) different color hues.

The 16-bit graphics modes are organized differently. Most common are (R-G-B) 5-6-5 (e.g. XGA) and 6-6-4 (e.g. i860). 5-6-5 means that 5 bits are used for each of red and blue and 6 bits are used for green. In the case of 6-6-4, 6 bits are used for red and green and 4 bits for blue. Both ways of assigning the bits correspond to the color sensitivity of the human eye: this is highest for green and lowest for blue. 65,536 different colors can be displayed.

TrueColor

The TrueColor mode is more complex, using 24 bits per pixel. Here, 8 bits are available for each color component (256 levels), resulting in 16.7 million different color hues. There are more colors available than pixels on the screen (1.3 million pixels at a resolution of 1280 x 1024).

4.2.7

VESA DDC (Display Data Channel)

The Display Data Channel provides a serial data channel between the monitor and the graphics board, as long as both support DDC and the monitor cable includes the additional DDC wire. An extended monitor cable is used. This feature allows the monitor data to be sent automatically to the graphics board (e.g. name, type, max. horizontal frequency, timing definitions etc.) or even for the graphics board to send instructions to the monitor.

There are various standards; DDC2B and DDC2AB.

4.2.8

DDC2B

A bi-directional data channel based on the I²C access-bus protocol is used for the communication between monitor and graphics board. In the case of a standard IBM VGA compatible 15-pin monitor connector, pin 12 (formerly

used as monitor ID bit 1) is used for data transmission (SDA), and the pin 15 (formerly used as monitor ID bit 3) is used as transmission clock (SCL). The graphics board can request the short EDID information (see DDC1) as well as the more comprehensive VDIF information (VESA Display Identification File).

4.2.9

DDC2AB

With DDC2AB additional to DDC2B, the computer can send commands for controlling the monitor, e.g. for adjusting the screen position or the brightness (similar to ACCESS bus). Modern monitors and graphics boards no longer use this standard.



The pin assignment of the VGA D-shell socket can be found in the chapter 'Technical data'.

5

Technical data

Those with a technical interest will find more detailed information regarding the *ELSA GLADIAC MX* in this chapter. All interfaces and their assignments are described in detail.

5.1

Characteristics of the graphics board

	<i>GLADIAC MX</i>
Graphics processor	GeForce 2 MX by NVIDIA
RAMDAC pixel timing	350MHz
On-board memory	32MB SDRAM
BIOS	Flash BIOS with VBE 3.0 support
Bus system	AGP 2.0
VESA DDC	DDC2B

5.2

ELSA graphics board addresses

The ELSA graphics boards are 100% IBM VGA compatible and occupy the same memory area and specific addresses in the I/O range. The memory range above 1 MB is automatically assigned through the PCI BIOS interface.



If you come across any address conflicts, try to modify the I/O address of the expansion board causing the conflict. The addresses of the ELSA graphics boards cannot be changed! The ELSA graphics board also requires an interrupt (IRQ) which is free. This may have to be reserved in the computer's BIOS. For help with this theme, refer to the manual for your mainboard.

To ensure that your system functions properly, the addresses and ranges occupied by the ELSA graphics board must not be accessed simultaneously by other hardware components. The following addresses are assigned:

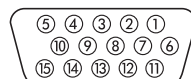
- **I/O addresses:**
Standard VGA I/O (3B0-3DF)
- **Memory addresses:**
Video RAM (A0000-BFFFF)
Video BIOS-ROM (C0000-C7FFF)

5.3 Ports on the graphics board

VGA D-shell socket
connector socket for the monitor
(15 pin)



5.3.1 The VGA D-shell socket



Pin assignments

Pin	Signal	Pin	Signal
1	red	9	+5V
2	green	10	sync ground
3	blue	11	not assigned
4	not assigned	12	bidirectional data (SDA, DDC2)
5	ground	13	horizontal synchronization
6	red ground	14	vertical synchronization
7	green ground	15	data clock (SCL, DDC2)
8	blue ground		

The *ELSA GLADIAC MX* issues analog signals in accordance with the requirements of directive RS-170. The synchronization information is sent separately. If your monitor supports the switching of input impedance, the '75 Ohm' setting (= '75Ω') should be chosen for the R, G and B video inputs and the '2 kOhm' setting (= '2kΩ') should be set for the sync inputs. You should not try other switch settings at the sync inputs unless your monitor expects a sync level that differs from that of most common monitors and does

not produce a stabile image. In some cases, the switch settings are labeled only with 'Low' and 'High'. If this is the case, either you can look up the Ohm values for the switch settings in the user manual provided with your monitor or you can try both settings to see which one produces a stabile image in all of the graphic display modes you require.

6 Appendix

6.1 CE conformity and FCC radiation standard

CE

This equipment has been tested and found to comply with the limits of the European Council Directive on the approximation of the laws of the member states relating to electromagnetic compatibility (89/336/EEC) according to EN 55022 class B.

FCC

This equipment has been tested and found to comply with the limits for a Class B digital device pursuant to Part 15 of the Federal Communications Commission (FCC) Rules. The following procedures were applied during conformity testing:

CE and FCC

These limits are designed to provide reasonable protection against radio frequency interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy. It may interfere with radio communications if not installed and used in accordance with the instructions. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception (this can be determined by turning this equipment off and on), the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the distance between this equipment and the receiver.
- Connect the equipment to an outlet on a circuit other than that to which the receiver is connected.
- Consult your dealer or an experienced radio/TV technician.
- Caution: To comply with the limits for an FCC Class B computing device, always use a shielded signal cable.



Caution to the user: The Federal Communications Commission warns the user that changes or modifications to the unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

6.2

Declarations of conformity

6.2.1

CE



KONFORMITÄTSERKLÄRUNG

DECLARATION OF CONFORMITY

Diese Erklärung gilt für folgendes Erzeugnis:

This declaration is valid for following product:

Geräteart:

Type of Device:

Grafikkarte

graphics board

Typenbezeichnung: ELSA GLADIAC MX

Product Name:

Hiermit wird bestätigt, daß das Erzeugnis den folgenden Schutzanforderungen entspricht

This is to confirm that this product meets all essential protection requirements relating to the

EMV Richtlinie (89/336/EWG)

EMC Directive (89/336/EEC)

Zur Beurteilung der Konformität wurden folgende **Normen** herangezogen:

The assessment of this product has been based on the following **standards**

EN 55022:1995 class B, EN 61000-3-2: 1995, EN 61000-3-3: 1995

EN 55024: 1998 Teile/ parts EN 61000-4-2, 3, 4, 5, 6, 8, 11

EN 60950:1992 +A1:1993 +A2:1993 +A3:1995 +A4:1997

Diese Erklärung wird verantwortlich für den Hersteller / Importeur

On behalf of the manufacturer / importer

ELSA AG

Sonnenweg 11

D-52070 Aachen

abgegeben durch

this declaration is submitted by

Aachen, 14. Juni 2000

Aachen, June 14th 2000

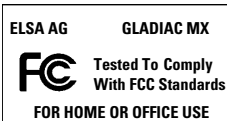
i.V. Stefan Kriebel

Bereichsleiter Entwicklung

VP Engineering

6.2.2

Declaration of Conformity (DoC)

**Compliance Information Statement**

(Declaration of Conformity Procedure)

Responsible Party: ELSA Inc.
Address: 1630 Zanker Road
San José, CA 95112
USA
Phone: +1-408-961-4600
Type of Equipment: Graphics Board
Model Name: GLADIAC MX

This device complies with Part 15 of the 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.

See user manual instructions if interference to radio reception is suspected.

On behalf of the manufacturer / importer
this declaration is submitted by

Aachen, June 14th 2000

Stefan Kriebel
VP Engineering
ELSA AG, Germany

6.3 Warranty conditions

The ELSA AG warranty, valid as of June 01, 1998, is given to purchasers of ELSA products in addition to the warranty conditions provided by law and in accordance with the following conditions:

1 Warranty coverage

- a) The warranty covers the equipment delivered and all its parts. Parts will, at our sole discretion, be replaced or repaired free of charge if, despite proven proper handling and adherence to the operating instructions, these parts became defective due to fabrication and/or material defects. Also we reserve the right to replace the defective product by a successor product or repay the original purchase price to the buyer in exchange to the defective product. Operating manuals and possibly supplied software are excluded from the warranty.
- b) Material and service charges shall be covered by us, but not shipping and handling costs involved in transport from the buyer to the service station and/or to us.
- c) Replaced parts become property of ELSA.
- d) ELSA are authorized to carry out technical changes (e.g. firmware updates) beyond repair and replacement of defective parts in order to bring the equipment up to the current technical state. This does not result in any additional charge for the customer. A legal claim to this service does not exist.

2 Warranty period

The warranty period for ELSA products is six years. Excepted from this warranty period are ELSA monitors and ELSA videoconferencing systems with a warranty period of 3 years. This period begins at the day of delivery from the ELSA dealer. Warranty services do not result in an extension of the warranty period nor do they initiate a new warranty period. The warranty period for installed replacement parts ends with the warranty period of the device as a whole.

3 Warranty procedure

- a) If defects appear during the warranty period, the warranty claims must be made immediately, at the latest within a period of 7 days.
- b) In the case of any externally visible damage arising from transport (e.g. damage to the housing), the transport company representative and ELSA should be informed immediately. On discovery of damage which is not externally visible, the transport company and ELSA are to be immediately informed in writing, at the latest within 7 days of delivery.
- c) Transport to and from the location where the warranty claim is accepted and/or the repaired device is exchanged, is at the purchaser's own risk and cost.
- d) Warranty claims are only valid if the original purchase receipt is returned with the device.

4 Suspension of the warranty

All warranty claims will be deemed invalid

- a) if the device is damaged or destroyed as a result of acts of nature or by environmental influences (moisture, electric shock, dust, etc.),
- b) if the device was stored or operated under conditions not in compliance with the technical specifications,
- c) if the damage occurred due to incorrect handling, especially to non-observance of the system description and the operating instructions,

- d) if the device was opened, repaired or modified by persons not authorized by ELSA,
- e) if the device shows any kind of mechanical damage,
- f) if in the case of an ELSA Monitor, damage to the cathode ray tube (CRT) has been caused especially by mechanical load (e.g. from shock to the pitch mask assembly or damage to the glass tube), by strong magnetic fields near the CRT (colored dots on the screen), or through the permanent display of an unchanging image (phosphor burnt),
- g) if, and in as far as, the luminance of the TFT panel backlighting gradually decreases with time, or
- h) if the warranty claim has not been reported in accordance with 3a) or 3b).

5 Operating mistakes

If it becomes apparent that the reported malfunction of the device has been caused by unsuitable software, hardware, installation or operation, ELSA reserves the right to charge the purchaser for the resulting testing costs.

6 Additional regulations

- a) The above conditions define the complete scope of ELSA's legal liability.
- b) The warranty gives no entitlement to additional claims, such as any refund in full or in part. Compensation claims, regardless of the legal basis, are excluded. This does not apply if e.g. injury to persons or damage to private property are specifically covered by the product liability law, or in cases of intentional act or culpable negligence.
- c) Claims for compensation of lost profits, indirect or consequential detriments, are excluded.
- d) ELSA is not liable for lost data or retrieval of lost data in cases of slight and ordinary negligence.
- e) In the case that the intentional or culpable negligence of ELSA employees has caused a loss of data, ELSA will be liable for those costs typical to the recovery of data where periodic security data back-ups have been made.
- f) The warranty is valid only for the first purchaser and is not transferable.
- g) The court of jurisdiction is located in Aachen, Germany in the case that the purchaser is a merchant. If the purchaser does not have a court of jurisdiction in the Federal Republic of Germany or if he moves his domicile out of Germany after conclusion of the contract, ELSA's court of jurisdiction applies. This is also applicable if the purchaser's domicile is not known at the time of institution of proceedings.
- h) The law of the Federal Republic of Germany is applicable. The UN commercial law does not apply to dealings between ELSA and the purchaser.

7 Glossary

- **3D** – Three-dimensional.
- **3D clipping** – A process within geometric transformation in which invisible areas or portions of a 3D object are removed.
- **3DNow!** – Extended command set used by AMD in the K6-2, K6-3 and K7 processors. 21 additional commands are intended above all to accelerate the floating-point operations that are especially important for 3D games.
- **3D pipeline** – The sum of all steps required in displaying an imaginary 3D scenario on the monitor. Included in this are ➡ [Geometrical transformation](#) and ➡ [Refresh rate](#).
- **AGP bus** – Abbreviation for Accelerated Graphics Port—a relatively new interface standard within the PC platform. Graphics boards take advantage of its high transfer rates for the display of 3D and full-motion video sequences.
- **Aliasing** – The well-known staircase effect. There is often a jagged transition between adjacent pixels when displaying slanted or curved lines. The rough transitions can be smoothed using anti-aliasing.
- **Alpha blending** – Supplementary information per pixel for generating transparent material.
- **Anisotropic filtering** – Method designed to reduce texture aliasing effects on surfaces at an angle to the viewer. Unlike other methods (such as ➡ [Bilinear filtering](#), ➡ [Trilinear filtering](#)) anisotropic filtering takes into account that such surfaces require a greater number of texture pixels for a clean display than surfaces that are perpendicular to the viewer. This especially enhances the legibility of text on angled planes (“Star Wars text”).
- **Anti-aliasing** – Methods for the reduction of ➡ [Aliasing](#) effects.
- **API** – Application Programming Interface. Software interfaces that provide applications with complete packages of functions. The most important 3D APIs are ➡ [DDR SDRAM](#) and ➡ [OpenGL](#).
- **Back buffer** – A portion of the graphics memory that is used to construct the image that is to appear on the monitor next. The back buffer is also used to calculate transparency effects.
- **Back-face culling** – Leaving out invisible areas.
- **Bilinear filtering** – In this case, a weighted average is calculated from four neighboring ➡ [Pixels](#) or ➡ [Texels](#) (2x2 matrix).
- **BIOS** – Abbreviation for basic input/output system. A code stored in the computer's memory (ROM), which carries out the self test and various other functions when the system is started.
- **Blitting** – Traditional method for ➡ [Buffer swapping](#): the contents of the ➡ [Bump mapping](#) is copied to the ➡ [Front buffer](#); slower than ➡ [Page flipping](#).

- **Buffer swapping** – The image prepared in the ➡ [Bump mapping](#) is displayed.
- **Bump mapping** – A technique that provides textures with depth information, which can be applied to display relief or embossed structures.
- **Bus system** – A system of parallel conductors for transferring data between individual system components, especially to expansion cards, such as ISA ➡ [Page flipper](#) and ➡ [AGP bus](#).
- **Chrominance** – Color information in the transfer of video signals.
- **Clipping** – Reduces the number of ➡ [Primitives](#) to be calculated. All primitives outside the limits of the screen (2D) or outside of the ➡ [Viewing pyramid](#) (3D) are clipped or removed.
- **Composite video** – A method of transferring video data signals, where the signals for ➡ [Chrominance](#) and ➡ [Luminance](#) are combined (also called FBAS).
- **Cube environment mapping** – In order to represent realistic and undistorted reflections of the environment onto an object, six ➡ [Textures](#) are viewed as the surfaces of a cube. The textures show the environment from the perspective of the object. This gives the impression that the environment is being reflected by the object. CEM is an extension of sphere environment mapping. The advantage of CEM is that no new textures need to be calculated when the observer's point of view changes and the texture is not distorted.
- **D/A converter** – Digital/analog converter: A signal converter that converts digital input to analog output.
- **DDC** – Abbreviation for Display Data Channel. A special data channel through which a DDC-capable monitor can send its technical data to the graphics board.
- **DDR SDRAM** – Double Data Rate SDRAM is a further development of ➡ [SDRAM](#) memory technology. While SDRAMs only provide data at the actual system clock speed, DDR chips permit data to be accessed at twice the system clock speed.
- **Direct3D** – Software interface (➡ [API](#)) developed by Microsoft for the manipulation and display of 3D content.
- **DirectColor** – Method to achieve the high-resolution ➡ [HighColor](#), ➡ [TrueColor](#) and ➡ [RealColor](#) graphics modes. In this case, the value stored in the video RAM (➡ [VRAM](#)) is not translated but is passed directly to the D/A converter ➡ [D/A converter](#). This means that the full color information must be saved for each ➡ [Pixel](#).
- **DirectDraw** – Software interface (➡ [API](#)) developed by Microsoft for the display of 2D content such as videos.
- **Double buffer** – Describes the presence of doubled display memory. This permits the next image to be generated first in the invisible background (➡ [Bump mapping](#)). As soon as it is completely constructed, the monitor display switches to the image

that has been residing in the background and the preparation of the next image begins on the other side.

- **DPMS** – Abbreviation for ➡ [VESA Display Power Management Signaling](#). This allows several stages of monitor power saving mode. The graphics boards described in this manual support VESA DPMS.
- **DRAM** – Abbreviation for Dynamic Random Access Memory. Dynamic random access memory with direct access.
- **EDO-RAM** – Abbreviation for Extended Data Output Random Access Memory (hyper page mode). EDO-RAM is especially advantageous in graphics boards because the most recently required data remains held in memory. Image rendering involves multiple consecutive read access of similar data, so EDO-RAM results in significantly faster speeds.
- **FBAS** – ➡ [Composite video](#)
- **FCC** – The FCC radiation standard states that this device has been tested and meets the requirements for digital class B devices in accordance with section 15 of the guidelines as provided by the American Federal Communications Commission (FCC).
- **FIFO method** – Abbreviation for first in, first out: A system used in batch processing and queues, in which the first arriving signal is processed first.
- **Fixed-frequency monitor** – A monitor that can only be operated with at a specific resolution and refresh rate.
- **Flat shading** – ➡ [Shading](#)
- **Frame buffer** – Memory on the graphics board containing display information, especially the ➡ [Front buffer](#) and ➡ [Bump mapping](#)
- **Front buffer** – Refers to the visible image area in the case of ➡ [Double buffer](#).
- **Full-scene anti-aliasing** – Describes a type of ➡ [Anti-aliasing](#) that is applied to a complete frame. Two processes are used in this form of anti-aliasing: Super sampling and Accumulated buffers. In the case of super sampling, a much higher resolution is calculated than the one to be displayed and then reduced. With the accumulated-buffer process, several views of a scene are drawn that are then combined to a single image.
- **Geometrical transformation** – The position of the objects in space is determined based on the observer.
- **Gouraud shading** – ➡ [Shading](#)
- **Graphics accelerator** – *GLADIAC MX* is a graphics accelerator card that is especially well-suited for the user environment that requires intense graphics.
- **HighColor** – Stands for a graphic display mode with 15 or 16 bit color depth per pixel (32,768 or 65,536 colors).
- **Horizontal frequency** – The monitor line frequency (horizontal scan frequency) in kHz. This value must be set according to the monitor's requirements to prevent the monitor from being damaged in extreme cases!

- **Horizontal scan frequency** – The monitor line frequency in kHz. This value must be set according to the monitor's requirements to prevent the monitor from being damaged in extreme cases!
- **Interpolation** – When displayed, video data must be stretched or shrunk to the correct window size. If the individual pixels are simply multiplied when stretched, unwanted blocks (the staircase effect, ➡ [Aliasing](#)) occur. This can be prevented using a filtering interpolation technique (averaging). While horizontal interpolation is easily accomplished, vertical interpolation is more complicated and requires buffered storage of the most recent image lines.
- **ISSE** – Extended Intel command set currently used in the Pentium III processors. 70 additional commands are intended above all to accelerate the floating-point operations that are especially important for 3D games.
- **Luminance** – Black/white information in the transfer of video signals.
- **MIP mapping** – MIP mapping assigns several textures with different resolutions to an object based on distance. If the observer gets closer to the object, the representation of the texture becomes more detailed.
- **MMX** – Extended Intel command set used by 166 MHz and higher Pentium processors bearing this designation. 57 additional commands accelerate especially integer operations.
- **Multifrequency (multisync) monitor** – A monitor that can be operated using different line frequency ranges and can adjust itself to different image signals (resolutions).
- **OpenGL** – 3D software interface (3D API). Such as implemented in Windows NT and optionally obtainable for Windows 95, this is based on Iris GL from Silicon Graphics and is licensed by Microsoft and ELSA.
- **Page flipping** – In the faster Page flipping method, only the buffer addresses are exchanged. The slower method (➡ [Blitting](#)) copies the contents of the ➡ [Back buffer](#) to the ➡ [Front buffer](#).
- **PCI bus** – Abbreviation for peripheral component interconnect bus. A system of parallel conductors for transferring data between individual system components, especially to expansion cards.
- **Phong shading** – ➡ [Shading](#)
- **Pixel** – A picture element
- **Pixel frequency** – Pixel cycle frequency: The number of drawn ➡ [Pixel](#) per second in MHz.
- **PolygonOffset** – ➡ [Z biasing](#)
- **Primitive** – Simple, polygonal, geometric objects, such as triangles. In most cases, 3D landscapes are broken down into triangles.
- **RAM** – Abbreviation for Random Access Memory. Main memory and memory expansion in ➡ [VRAM](#) or ➡ [DRAM](#) depending on the graphics board.

- **RAMDAC** – On a graphics board, RAM-DAC is responsible for converting digital signals into analog signals. VGA monitors can only process analog signals.
- **RealColor** – In general, stands for a 15 or 16-bit-per-pixel-wide graphic display mode (32,768 or 65,536 colors).
- **Refresh rate** – Indicates (in Hz) how often the image on the monitor is rebuilt per second.
- **Rendering** – The calculative process for representing 3D scenery, where position and color are determined for each point in space. The depth data are located in the [Z buffer](#) while the color and size data are in the [Frame buffer](#).
- **Resolution** – The number of pixels in both horizontal and vertical directions (e.g. 640 horizontal x 480 vertical pixels).
- **RGB** – Color data stored in red/green/blue format.
- **ROM** – Abbreviation for Read Only Memory. Solid state memory that can be read from only.
- **S-video** – Or S-VHS. A method of transferring video data signals, where the signals for [Chrominance](#) and [Luminance](#) are separated. This results in improved image quality.
- **SDRAM** – Synchronous Dynamic Random Access Memory. These memory chips are based on standard DRAMs ([DRAM](#)), but are fast enough to permit data access at the clock speed of the [Bus system](#). This eliminates the wait states typical of DRAMs. They consist of two separate memory ranges, with one preparing data for access while the other is actually still being accessed.
- **Shading** – The shading of curved areas to make them appear as realistic as possible. To do so, the curved areas are divided into many small triangles. The three most important 3D shading methods differ by how the color gradients within the triangles are represented: Flat shading: The triangles are colored uniformly. Gouraud shading: The color gradient is determined by the interpolation of the corner color values. Phong shading: The color gradient is determined by the interpolation of the normal vector plus the calculation of the light incidence for each pixel. These shading methods are not supported directly in the standard OpenGL API.
- **Single buffer** – Unlike the [Double buffer](#), where there is doubled display memory, single buffer mode does not allow access to the next prepared image, resulting in animation that is not smooth.
- **Sphere environment mapping** – [Cube environment mapping](#).
- **Stencil buffer** – This buffer permits the color information of the [Pixel](#) to be supplemented with further information. This can be used to create stencils, volumetric shadows and reflective surfaces, for example.
- **Strips and fans** – Process for the reduction of data volume required for complex 3D objects. Strips are used for objects consisting of several parallel rows of triangles. Rather than calculating each individ-

ual triangle, the vertices are transferred only once. A fan object is used when several triangles converge to a single point. In this case, the vertices are also transferred only once. These processes can reduce the data volume by approximately a third.

- **Tearing** – If there is no synchronization with the monitor when switching between images (pages) in [MIP mapping](#) mode, areas of the images can become offset. To resolve this, the switching between pages is synchronized with the monitor frequency (Wait on Vertical Blank).
- **Tessellation** – Tessellation subdivides objects into polygons (e.g. triangles) for 3D rendering. For these primitives, the corner point and color values as well as the transparency value if necessary are determined. Tessellation is currently performed by the application, i.e. upstream of the [3D pipeline](#).
- **Texel** – Individual pixel of a [Texture](#).
- **Texture** – The overlaying of a surface with a texture with correction for perspective, such as a wood grain or the drawing of a wall with wallpaper in a perspective view. Videos, too, can be used as a texture.
- **Transformation & Lighting (T&L)** – Using T&L, the main computer processor is freed up from the consuming task of computing geometric calculations. This computational process, which includes all of the coordinates of a 3D object during rotation, shifting, scaling and color, is taken over by the graphics board processor.
- **Trilinear filtering** – This is a mixture of [MIP mapping](#) and [Bilinear filtering](#).
- **TrueColor** – A graphic display mode with max. 16.7 million colors, i.e. a color depth of 24 or 32 bits per pixel.
- **VESA** – Abbreviation for Video Electronics Standards Association. A consortium for standardizing computer graphics.
- **Viewing pyramid** – Designation for the part of a 3D space located within the viewer's field of vision.
- **VRAM** – Abbreviation for Video RAM. A module for upgrading the memory on a graphics board to display higher resolutions and color depths.
- **Z biasing** – [DDR SDRAM](#) method for the correct display of various objects with the same depth coordinates. A typical example is the display of a shadow on a wall: both objects have the same Z (depth) coordinates, but the shadow must appear on the wall (not vice versa). The included Z bias value ensures the correct display. Under [OpenGL](#), this functionality is called PolygonOffset.
- **Z buffer** – The 3D depth information of a pixel (the position in the 3rd dimension).

8

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