

A key feature of the Matrox Imaging Library (MIL) is its versatile and automatic display management. It provides flexible live video display without consuming precious host CPU power. However, there are circumstances where hardware and/or software restrictions will affect the availability of certain display features and/or the extent of how much the host CPU is implicated.

The purpose of this document is to describe the restrictions with the display of a live video-in-a-window, non-destructive graphics overlay and/or non-tearing display. This document will also cover restrictions with multi-screen display configurations. It is important to note that the amount of host CPU intervention depends on the speed of the host CPU, and that it can be compounded by multiple restrictions. The topics discussed here are specific to MIL/MIL-Lite 7 and are intended to complement the information already covered in the MIL 7 User Guide, Command Reference and Board Specific Notes manuals.

Essentials of Hardware Display Architectures

There are two types of hardware display architectures supported by MIL: Microsoft® DirectDraw®-enabled or Matrox Imaging legacy. The first architecture utilizes Microsoft® DirectDraw® services in conjunction with related graphics controller hardware (e.g., backend scalar) to implement video and graphics display. This type of architecture is used with the Millennium G-series of Matrox graphics boards (e.g., G200, G400, G450, G550) as well as Matrox Imaging hardware equipped with the Matrox G-series graphics controllers (e.g., Matrox Corona-II, Orion, 4sight-II). The DirectDraw®-enabled architecture features a single bank of display memory, which is accessed by MIL through DirectDraw®. For the remainder of this document, any reference to the G-series board applies to Matrox Graphics and Matrox Imaging boards that use the Matrox G-series graphics controllers.

The Matrox Imaging legacy architecture is an older implementation that relies on two independent banks of display memory. One bank of memory (underlay buffer) is used exclusively for video, while the other bank of memory (overlay buffer) is used for the Windows® desktop, keying color and graphics overlay. With the legacy architecture, display control is performed directly by MIL.

What about using a non-Matrox graphics controller with MIL?

While MIL is specifically optimized for Matrox graphics controllers, non-Matrox graphics controllers can also be used with MIL. However, Matrox Imaging does not perform extensive testing with non-Matrox graphics controllers.

By default, MIL does not use DirectDraw® services with non-Matrox graphics controllers simply to avoid any chance of incompatibility problems with the non-Matrox video drivers. To enable the use of DirectDraw® services, create a MIL.INI file (in the WINNT or WINDOWS directory for Windows NT 4.0/2000/XP or 98/Me respectively) and add the following key:

```
[VGA]
UseDDDrawUnderlay=1
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Video-in-a-window

Video-in-a-window mode, as the term implies, is a windowed¹ display of live video on the Windows® desktop (see Figure 1) performed with or without host CPU intervention. Video-in-a-window using DirectDraw®-enabled hardware architecture is performed by MIL allocating two regions of the display memory, one in the on-screen and one in the off-screen portion of memory, and then creating a composite of the two regions before the actual display. The on-screen region stores the Windows® desktop, as well as the video window but with the keying color instead of the video, while the off-screen region stores the actual video (see Figure 2). When the backend scalar is available, a merge command from the host CPU is not necessary since the backend scalar automatically combines the on-screen and off-screen regions for each display refresh. However, if the backend scalar is unavailable (see Table 1), MIL utilizes the next best method, such as transferring the live video directly to the on-screen region but with negligible host CPU intervention, or uses off-screen/host memory and a blitting operation with host CPU intervention to update the display. The amount of host CPU usage depends on the operations being performed as well as the host CPU speed.

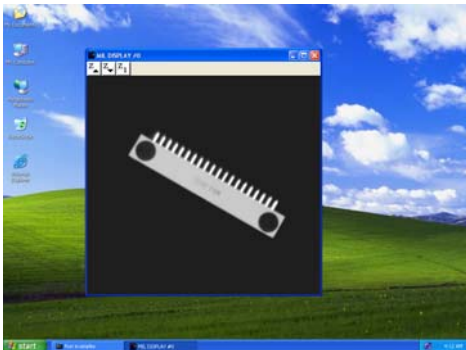


Figure 1: Microsoft® Windows® XP desktop with video window

Video-in-a-window mode for the Matrox Imaging legacy hardware architecture (see Figure 3) is performed using two individual banks of memory (underlay and overlay). The underlay memory is used exclusively for the video, while the overlay memory is used for the Windows® desktop, the video window and the keying color. The live video is displayed through the keying color area in overlay memory. This type of architecture, found on the Matrox Genesis/Genesis-LC boards, relies on the display hardware to combine the contents of the overlay and underlay memory. In most cases the video-in-a-window requires no host CPU intervention. However, there are some restrictions (see Table 2) that will introduce host CPU intervention.

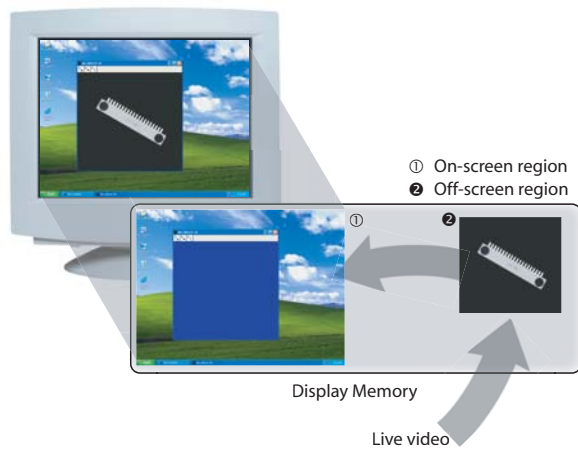


Figure 2: Video-in-a-window mode with DirectDraw®-enabled hardware architecture

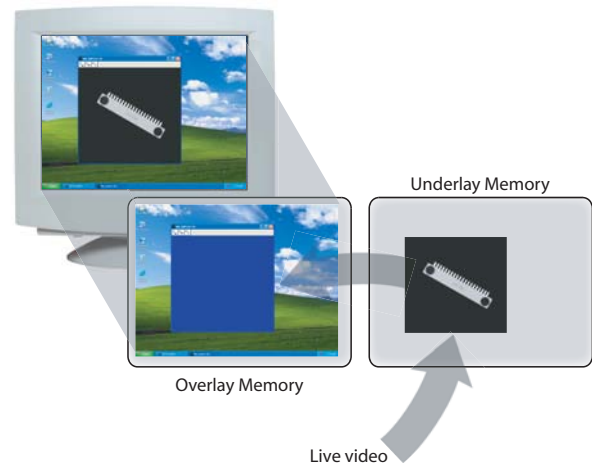


Figure 3: Video-in-a-window mode with Matrox Imaging legacy architecture

1. MIL or custom window.



Non-Destructive Graphics Overlay of Live Video

Non-destructive graphics overlay is simply the display of graphics on top of live video without destructively altering the video (see Figure 4). As with video-in-a-window, the type of support for non-destructive graphics overlay without host CPU intervention depends on the type of display architecture. Note that the restrictions for video-in-a-window (Table 1) are also applicable for non-destructive graphics overlay.

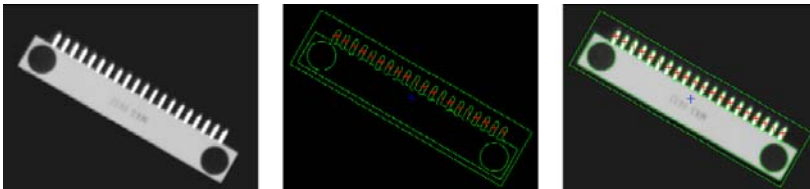


Figure 4: Graphics overlay (original, graphics overlay, combined)

For DirectDraw®-enabled hardware architecture, non-destructive graphics overlay without host CPU intervention is achieved by MIL allocating three regions of display memory, one on-screen and two off-screen (see Figure 5). Again, the on-screen region stores the Windows® desktop, as well as the video window. The off-screen regions are used for the live video and a composite of keying color and graphics overlay. The composite and live video regions are merged with the on-screen region to produce the final display. The live video is displayed through the keying color along with any graphics overlay displayed on top, all without flicker. The actual update of the display is performed without host CPU intervention by the graphics controller's backend scalar. If the backend scalar becomes unavailable due to a restriction (see Table 2), MIL utilizes the next best method, which combines the live video with the graphics overlay in another off-screen region before merging with the on-screen region using blit operations (see Figure 6). This approach ensures that the live video with graphics overlay is still flicker-free, but does require some host CPU intervention.

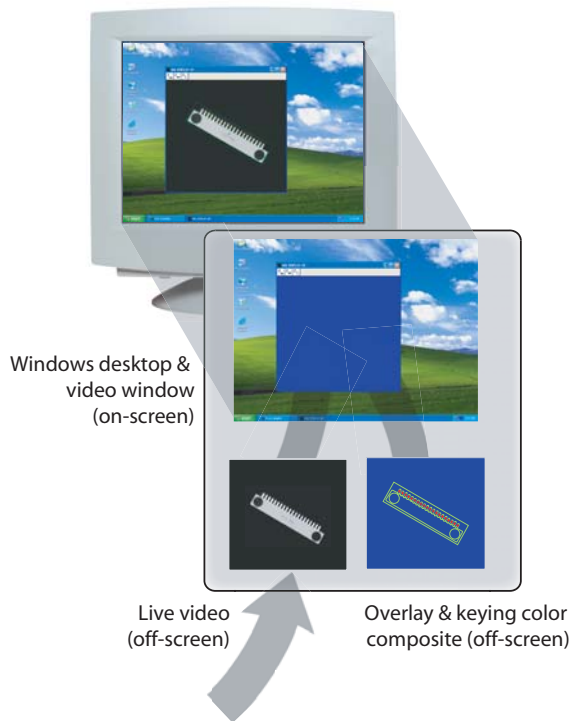


Figure 5: Non-destructive graphics overlay with DirectDraw®-enabled hardware architecture and with backend scalar

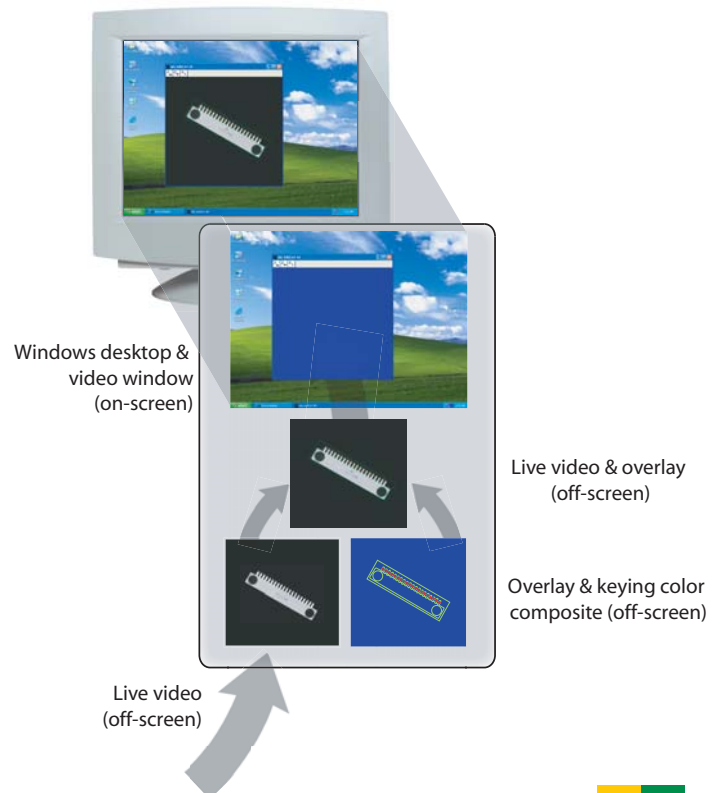


Figure 6: Non-destructive graphics overlay with DirectDraw®-enabled hardware architecture but without backend scalar



Non-Destructive Graphics Overlay of Live Video (continued)

The legacy architecture uses underlay memory for the live video while overlay memory is used for the Windows® desktop, keying color and graphics overlay. The live video located in underlay memory is displayed through the keying color region in overlay memory, along with any graphics overlay displayed on top of the live video (see Figure 7). When a restriction applies, display updates are performed by the graphics controller's blit operation, which requires some host CPU intervention.

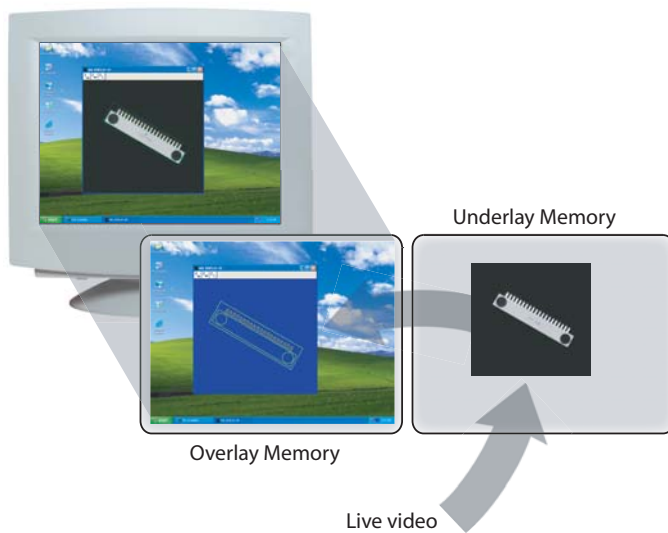


Figure 7: Non-destructive graphics overlay with Matrox Imaging legacy hardware architecture

Non-tearing Display

A tearing artifact occurs when video capture and display are not refreshed synchronously. The asynchronous refresh of the video capture buffer and display causes two successive video images to temporarily appear simultaneously with the appearance of a tear scrolling through the image (see Figure 8). Tearing artifacts can also occur when a blit operation is performed to a memory location (buffer) that is simultaneously being displayed. Live video display without a tearing artifact can only be achieved when the graphics controller has a backend scalar available (see Table 3). To eliminate the tearing artifact, MIL allocates four regions of display memory. One memory region is used to store the live video, while the other three regions are used to perform triple buffering to ensure that only one complete frame of the video is displayed at once.



Figure 8: Tearing artifact

Multi-screen Display Configurations

MIL supports three types of multi-screen configurations: Extended, Auxiliary and a combination of the two (see Figure 9). The availability of these display configurations depend on the hardware and the operating system. The extended desktop mode, originally called "multi-head", "multi-screen" or "dual-head" mode, is an extended Windows® desktop spanned across two or more monitors in a horizontal, vertical or diagonal² fashion. This configuration is achieved using multiple graphics controllers (e.g., two or more Millennium G200 boards) or a single graphics controller with two CRT controllers (e.g., Millennium G400/G450/G550 board) (see Figure 10). Auxiliary mode, originally called "non-windowed" or "dual-screen" mode, is the non-windowed display of video exclusively through MIL on a VGA monitor or TV. TV display uses the video encoder and is only available to a MIL application. The combination mode is simply a mix of extended desktop over two or more monitors with auxiliary display on one or more VGA monitors or TVs (see Figure 9). Since video-in-a-window and non-destructive graphics overlay can be performed on an extended desktop, the respective restrictions (Table 1) are also applicable in addition to those listed for the extended desktop mode. Moreover, since non-destructive graphics overlay can also be applied to an auxiliary display, the respective restrictions are also (Table 1) applicable in addition to those listed for auxiliary mode.

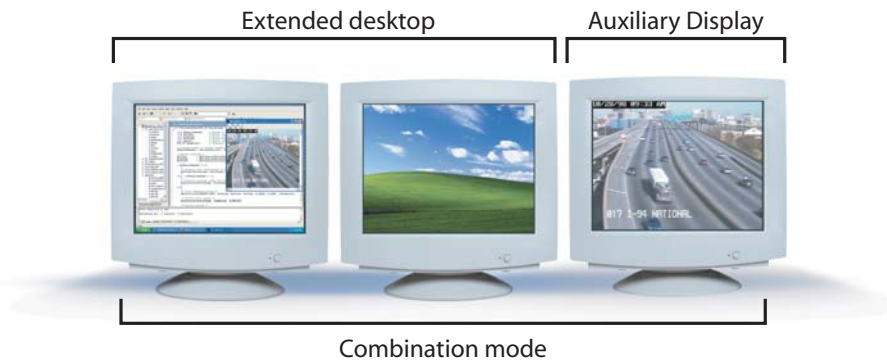


Figure 9: Multi-screen display configurations



Figure 10: Multi-screen display configurations using multiple or a single graphics controller(s)

2. See restrictions table.



Table 1: Video-in-a-window/non-destructive overlay restrictions
Single monitor configuration using G-series boards.

Feature	Restriction	Consequence
Microsoft® Windows® desktop resolution and refresh rate	Maximum desktop resolution/refresh rate of 1280 x 1024 @ 75 Hz. Exceeding this setting will result in a loss of the backend scalar.	MIL grabs to on-screen memory (negligible host CPU intervention). With additional restrictions, MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
Video window	Maximum <u>horizontal</u> width of 1024. No maximum <u>vertical</u> width. Horizontal width higher than 1024 results in a loss of the backend scalar.	MIL grabs to on-screen memory (negligible host CPU intervention). With additional restrictions, MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
Video pixel format	Only YUV16 and BGR32 ³ buffer formats are supported by the backend scalar. The YUV16 buffer format is supported by all G-series boards, while the BGR32 buffer format is supported only with G450/G550-based boards. If the digitizer does not support a grab in YUV16 or BRG32 formats, video display cannot be performed using backend scalar.	MIL grabs to on-screen memory (negligible host CPU intervention). With additional restrictions, MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
Child buffer format	If the display buffer is a child band of a color buffer, then the result is a loss of the backend scalar and ability to grab to on-screen memory.	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
Display control	Use of MdispControl(..., M_AUTO_SCALE or M_BIT_SHIFT) with a bit shift not equal to zero will result in a loss of the backend scalar and the ability to grab to on-screen memory.	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
	Using an unsupported zoom increment will result in a loss of the backend scalar.	MIL grabs to on-screen memory (negligible host CPU intervention). With additional restrictions, MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
	With G400-based boards under Windows NT 4.0, zoom-out is limited to 1/3. Zooming-out beyond 1/3 will result in a loss of the backend scalar.	MIL grabs to on-screen memory (negligible host CPU intervention). With additional restrictions, MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
Multiple video windows	When displaying multiple video windows, only the first allocated video window uses the backend scalar.	For additional video windows, MIL grabs to on-screen memory (negligible host CPU intervention). With additional restrictions, MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
LUTs	Off-screen region (underlay surface) cannot have access to LUTs.	MIL grabs directly to on-screen memory (negligible host CPU intervention). With additional restrictions, MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
Multiple Document Interface (MDI)	A video window within a Visual Basic® MDI application results in a loss of the backend scalar and the ability to grab to on-screen memory.	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).

3. BGR32 not available by default, requires creating a MIL.INI file and adding the following key:
[VGA]
UseDDDrawUnderlay=1



Table 1: Video-in-a-window/non-destructive overlay restrictions (continued)
Single monitor configuration using G-series boards.

Feature	Restriction	Consequence
Video capture using Matrox Orion	Cannot capture directly to on-screen memory.	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
	When the interpolation mode of the Matrox Orion is not set to M_DEFAULT (M_NEAREST_NEIGHBOR) and when grabbing directly to on-screen memory.	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
	Display properties settings must be 8 or 32-bit .	Capture not supported in other settings.
Video capture using Matrox Meteor-II	Display properties settings must be 8, 24 or 32-bit for monochrome and 24 or 32-bit for color video.	MIL grabs directly to on-screen memory (negligible host CPU intervention). With additional restrictions, MIL uses host memory and blit or buffer copy operations (host CPU intervention).
Video capture using Matrox Meteor-II/Multi-Channel	Backend scalar is available for MONO8 with all G-series boards or for BRG32 for only G450/550 boards ⁴ .	MIL grabs directly to on-screen memory (negligible host intervention). With additional restrictions, MIL uses host memory and blit or buffer copy operations (host CPU intervention).
Window focus	When grabbing directly to on-screen memory and video window losses the main focus (becomes inactive).	MIL uses host memory and buffer copy operations (host CPU intervention).

Table 2: Video-in-a-Window/Non-destructive Overlay Restrictions
Single monitor configuration using a Matrox Genesis/Genesis-LC board.

Feature	Restriction	Consequence
Windows® Desktop	Maximum possible resolution is 1600 x 1280 x 8-bit.	Higher desktop resolutions or display depths not supported.
Video window	Only 8 or 24-bit depth supported.	16 or 32-bit depth not supported.
Buffer format	Display buffer is a child band of a color buffer.	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
	Use of MdispIControl(..., M_AUTO_SCALE or M_BIT_SHIFT) with a bit shift not equal to zero.	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
Multiple video windows	When displaying multiple video windows, only the first allocated video window does not require host intervention.	For the additional video windows, MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
LUTs	The underlay region cannot have access to the LUTs.	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
Multiple Document Interface (MDI)	A video window within a Visual Basic® MDI application results in host CPU intervention.	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).

4. Backend scalar can be made available only with G450/G550-based boards for BGR32 format by creating a MIL.INI file and adding the following key:
[VGA]
UseRGB32DDrawOverlaySurface=1



Table 3: Non-tearing Live Video Restrictions
Single or multi-screen configurations using G-series boards.

Feature	Restriction	Consequence
Video/image display	Only available for live video.	Tearing artifact cannot be eliminated for single image capture or host/VGA copy to a display buffer.
Backend scalar	Not available if the backend scalar is already in use.	Tearing artifact cannot be eliminated.
Multiple video windows	Only available with first allocated video window.	Additional video windows will have tearing artifact.
Auxiliary display*	Five field delay (versus two without) between video capture and TV display.	Display latency.
Combination display*	With simultaneous video-in-a-window and auxiliary TV display mode, non-tearing mode can only be applied to the TV display.	Tearing artifact will not be eliminated on the video window.

* Refer to the Multi-screen Display Configuration section for additional information and restrictions.

Table 4: Multi-screen Restrictions
Multi-screen configurations using G-series boards.

Feature	Restriction	Consequence
Hardware	Extended desktop and/or auxiliary display requires at least two graphics controllers (G200), or one graphic controller that integrates two CRT controllers (G400/450/550).	Without minimum hardware, extended desktop and/or auxiliary display not supported.
	Only one auxiliary display per graphics controller is supported.	Without additional graphics controllers, additional auxiliary display(s) not available.
	Using two graphic cards for an extended desktop where one graphic card is set for 8-bit depth and the other is set to a different display depth will result in loss of backend scalar.	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
	Using the two CRT controllers of the G400/G450/G550-based boards for an extended desktop will result in loss of backend scalar.	MIL grabs directly to on-screen memory (negligible host CPU intervention). With additional restrictions, MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
	Using the Matrox Orion to grab in the memory of another display board will result in a loss of the backend scalar (e.g., using a Matrox Orion and G400 graphics board for an extended desktop, and video window is moved to second display).	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
DirectDraw/DirectX	DirectDraw is not available under Windows NT 4.0 when using an extended desktop, resulting in a loss of the backend scalar.	MIL grabs directly to on-screen memory (negligible host CPU intervention). With additional restrictions, MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).
	Windows 98/98SE requires DirectX 7 or higher for extended desktops.	MIL does not function.
Video window placement	In Extended desktop mode, placing the video window between two monitors will result in a loss of the backend scalar.	MIL uses off-screen/host memory and blit or buffer copy operations (host CPU intervention).



Table 4: Multi-screen Restrictions (continued)

Multi-screen configurations using G-series boards.

Feature	Restriction	Consequence
Extended Desktop resolution	When using the second CRT output of a G400/G450-based board, the auxiliary screen is only available when the desktop property settings for both are set to 32-bit.	Auxiliary screen will not be allocated.
Extended Desktop layout	Extended desktop in diagonal fashion supported only under Windows 98/98SE, Windows Me, Windows 2000 and Windows XP.	Diagonal format not supported under Windows 95 and NT 4.0.
Auxiliary screen (VGA and TV output)	The second CRT output of the G400-based board does not support TV video formats.	Auxiliary TV output not supported.
	When using the auxiliary TV output, only YUV12 and YUV16 (NTSC/PAL) buffer formats are supported.	Auxiliary TV output not supported.
	The second CRT output of the G400/G450/G550-based board only supports BRG32 buffer format.	Auxiliary VGA output not supported.
	To use the second CRT output of the G400/G450/G550-based boards for an auxiliary screen, the display drivers' DualHead mode must be disabled.	Auxiliary screen will not be allocated.
	Cannot allocate an auxiliary screen with a G-series based board featuring both analog RGB and DVI output ⁵ .	Auxiliary screen will not be supported.
	Under Windows NT 4.0, if the auxiliary screen is driven by the same board as the Windows desktop screen, the desktop resolution must be larger than the auxiliary screen resolution.	Auxiliary screen will not be supported.

5. Includes G550 boards, select non-retail SKUs G450 boards and G450/G200 mms boards. This restriction does not apply to the Matrox 4Sight-II.

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