

WinG Programmer's Reference BETA VERSION

Please read the [readme.txt](#) file installed with the WinG Development Kit for important late-breaking news and known bugs before reporting any bugs you find!

[Click Here](#) to read the WinG beta readme file.

Philosophy and Overview of WinG

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Managing Palettes in a WinG Application

DOS executes only one application at a time, so every DOS application has the freedom to modify the hardware palette on palette devices (such as VGA) without interfering with other active applications. In the multitasking Windows environment, applications must modify the palette through the Palette Manager to ensure friendly interoperability of applications.

The most common programming error in palettized Windows applications is that the system selects the stock system palette in devices acquired through `GetDC` or through a `WM_PAINT` message. The application must call `SelectPalette` and `RealizePalette` to set and activate a palette in these DCs, and the palette information survives in the DC only in the time between `GetDC` and `ReleaseDC` calls.

The following code snippet will result in an image mapped to the static colors:

```
HDC hdc = GetDC(hwnd);
SelectPalette(hdc, hpal, FALSE);
RealizePalette(hdc);
ReleaseDC(hwnd, hdc);           // Palette information lost!!
...
hdc = GetDC(hwnd); // DC with stock palette selected!!
BitBlt(hdc, x,y,width,height, source, 0,0, SRCCOPY);
ReleaseDC(hwnd, hdc);
```

Ron Gerys article [The Palette Manager: How and Why](#) (Microsoft Technical Article, 23 March 1992) describes the mechanisms of the Palette Manager in depth. The following articles discuss optimizing Palette Manager use in WinG applications.

[Using an Identity Palette](#)

[Palette Animation With WinG](#)

[Accessing a Full Palette Using SYSPAL_NOSTATIC](#)

Why WinG?

Although business applications such as word processors and spreadsheets have moved almost exclusively to Windows, DOS remains the operating system of choice for high-volume, high-performance action games and innovative graphics applications for PCs. These applications have not made the transition to Windows because of restrictions placed on the programmer by GDI's device independence, by the windowed environment, and by the inability of general graphics libraries to provide the necessary speed.

The display techniques used by high-performance graphics applications have two common characteristics. First, the application hides the frame composition process by double-buffering in software or hardware. Second, programmers use knowledge specific to the problem at hand to optimize their graphics routines in ways a general graphics library can not.

Hiding frame composition eliminates flicker by presenting only completed frames to the user. Under DOS, a VGA card can accomplish the display in hardware by page flipping, or the buffer can reside in main memory which is copied to the screen. Some applications further optimize display access by copying only the areas of the buffer that have changed since the last frame, a process called dirty rectangle animation. Today, high-performance DOS games use all of these techniques.

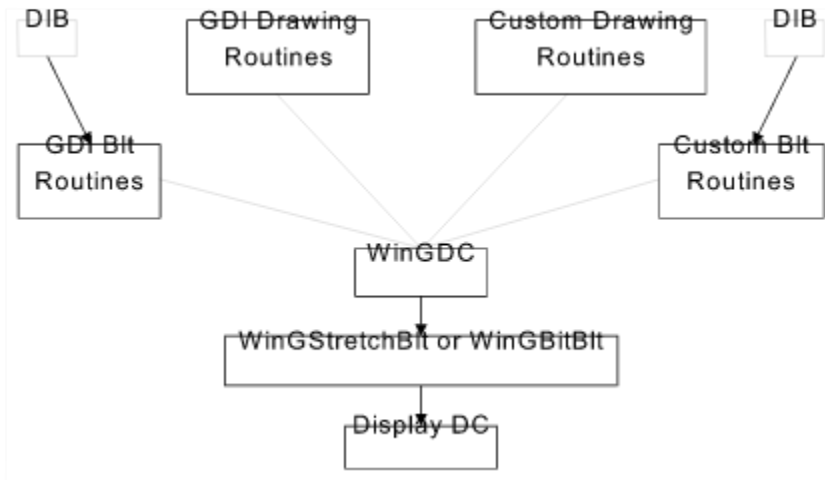
In short, most DOS games programmers use knowledge specific to their application and their hardware to write optimized graphics routines. Until now, Windows programmers could not use such methods because GDI prevents access to device-specific surfaces; programmers can not draw directly onto the surface of a GDI device context.

WinG (pronounced "Win Gee") is an optimized library designed to enable these high-performance graphics techniques under Windows 3.1, Win32s, and future Windows releases. WinG allows the programmer to create a GDI-compatible HBITMAP with a Device Independent Bitmap (DIB) as the drawing surface. Programmers can use GDI or their own code to draw onto this bitmap, then use WinG to transfer it quickly to the screen. WinG also provides halftoning APIs that use the standard Microsoft halftone palette to support simulation of true color on palette devices.

Off-screen Drawing With WinG

WinG introduces a new type of device context, the WinGDC, that can be used like any other device context. Unlike other DCs, programmers can retrieve a pointer directly to the WinGDC drawing surface, its BITMAPINFOHEADER, and its color table. They can also create and select new drawing surfaces for the WinGDC or modify the color table of an existing surface. DIBs become as easy to use as device-specific bitmaps and compatible DCs, and programmers can also draw into them using their own routines.

Most often, applications will use WinGCreateDC to create a single WinGDC and will use WinGCreateBitmap to create one or more WinGBitmaps into which they compose an image. The application will typically draw into this buffer using DIB copy operations, GDI calls, WinG calls, and custom drawing routines, as shown here.



A double-buffering architecture for WinG

Once drawing, DIB composition, and sprite composition for the current frame is complete, the application will copy the WinGDC buffer to the screen using WinGStretchBlt or WinGBitBlt. This double-buffering architecture minimizes flicker and provides smooth screen updates.

Many games and animation applications draw their characters using sprites. On arcade machines, sprite operations are performed in hardware. Under DOS with a VGA, games simulate sprite hardware using transparent blts into an off-screen buffer. The DOGGIE sample application (in the SAMPLES\DOGGIE directory of the WinG development kit) uses WinG in the same way to perform transparent blts to a WinGDC and includes source code for an 8-bit to 8-bit TransparentDIBits procedure.

Using GDI With WinGDCs

WinG allows drawing onto the DIB surface of a WinGDC with GDI, but there are some anomalies to keep in mind.

1. Most importantly, GDI does NOT regard WinGDCs as palette devices. WinGDCs are actually 256-color RGB devices. You happen to be able to modify the device color table using the [WinGSetDIBColorTable](#) API. The [Palette Animation With WinG](#) article describes how to match a given palette to a WinGDC color table.
2. Drawing with GDI on a WinGDC surface does not always produce a pixel-perfect duplicate of the image you would see using GDI on a display device. The images will be acceptably similar, but some stray pixels will remain if you XOR the two images together.
3. Brushes realized in a WinGDC will be aligned to the upper left corner of the WinGDC whereas brushes used in screen DCs are aligned to the upper left corner of the screen. This means that when you blt a WinGDC that has been filled with a pattern into a screen DC that has been filled with the same pattern, the patterns will not necessarily align correctly.

If you have this problem, you can either change the brush origins and re-realize the brushes in either DC (see the section 1.6.8 Brush Alignment in the Windows SDK Programmers Reference Volume 1, also available on the Microsoft Developer Network CD) or you can make off-screen brushes align correctly with on-screen brushes by blting the WinGDC to a brush-aligned position on the screen. For example, an 8x8 brush pattern can be correctly aligned to the screen by blting the WinGDC to an x, y position when x and y are both multiples of 8.

4. Win32 applications that use GDI and custom drawing routines to draw on the surface of a WinGBitmap should call [GDIFlush](#) after calling GDI functions and before calling custom functions. Win32 GDI batches drawing commands, and this will guarantee that all GDI drawing is completed before custom drawing begins. Without this call, drawing may be done in an incorrect order.

Halftoning With WinG

WinG allows applications to simulate true 24-bit color on 8-bit devices through the WinG halftoning support APIs, [WinGCreateHalftonePalette](#) and [WinGCreateHalftoneBrush](#).

The [halftone palette](#) is an [identity palette](#) containing a carefully selected ramp of colors optimized for dithering true color images to 8-bit devices. The [WinGCreateHalftonePalette](#) function returns a handle to a [halftone palette](#) which applications can select and realize into a display device context to take advantage of the halftoning capabilities offered by WinG.

The brushes returned by the [WinGCreateHalftoneBrush](#) API use patterns of colors in the halftone palette to create areas of simulated true color on 8-bit devices into which the halftone palette has been selected and realized. The [CUBE](#) sample application (in the SAMPLES\CUBE subdirectory of the WinG development kit) uses halftoned brushes to generate a wide range of shaded colors on an 8-bit display.

The [halftone palette](#) gives applications a framework for dithering 24-bit images to 8-bit devices. The palette itself is a slightly modified 2.6-bit-per-primary RGB cube, giving 216 halftoned values. The 256-color [halftone palette](#) also contains the twenty [static colors](#) and a range of gray values.

Given a 24-bit RGB color with 8 bits per primitive, you can find the index of the nearest color in the halftone palette using the following formula:

$$\begin{aligned} \text{HalftoneIndex} &= (\text{Red} / 51) + (\text{Green} / 51) * 6 + (\text{Blue} / 51) * 36; \\ \text{HalftoneColorIndex} &= \text{aWinGHalftoneTranslation} [\text{HalftoneIndex}]; \end{aligned}$$

The [aWinGHalftoneTranslation](#) vector can be found in the [HALFTONE](#) source code. The [HALFTONE](#) sample (in the SAMPLES\HALFTONE subdirectory of the WinG development kit) applies an ordered 8x8 dither to a 24-bit image, converting it to an 8-bit DIB using the WinG Halftone Palette.

Applications should avoid depending on a specific ordering of the [halftone palette](#) by using [PALETTERGB](#) instead of [PALETTEINDEX](#) to refer to entries in the palette.

Maximizing Performance With WinG

Here is the WinG Programmers Guide to Achieving WinG [Nirvana](#), the Top Ten ways to maximize bit performance under Windows using WinG.

10. Take Out Your Monochrome Debugging Card and Unplug Network Connections

Eight bit monochrome video cards can turn the 16 bit 8 MHz ISA bus into an 8 bit 4 MHz PC bus, cutting your video bus bandwidth by up to 75%. Monochrome cards are an invaluable aid when debugging graphical applications, but when timing or running final tests, remove the card for maximum speed.

Incoming network packets during WinG runtime profiling cause asynchronous interrupts that steal CPU time from the time-sensitive profiling process. This may result in noticeable timing errors that lead to sub-optimal performance. For best results, unplug any network connections before running a WinG application for the first time on a new configuration, then plug the network connection back in when the WinG profiling process is complete.

9. Store WinGBitmap Surface Pointer and BITMAPINFO

[WinGCreateBitmap](#) takes a [BITMAPINFO](#), creates an [HBITMAP](#), and returns a pointer to the new bitmap surface. Store the [BITMAPINFO](#) and pointer at creation time with the [HBITMAP](#) rather than call [WinGGetDIBPointer](#) when you need it.

8. Dont Make Redundant GDI Calls

GDI objects such as brushes, fonts, and pens, take time to create, select, and destroy. Save time by creating frequently used objects once and caching them until they are no longer needed. Move the creation and selection of objects as far out of your inner loops as possible.

7. Special Purpose Code May Be Faster Than GDI

There may be many ways to accomplish a given graphics operation using GDI or custom graphics code in your application. Special purpose code can be faster than the general purpose GDI code, but custom code often incurs associated development and testing overhead. Determine if GDI can accomplish the operation and if the performance is acceptable for your problem. Weigh the alternatives carefully and see number 6 below.

6. Time Everything, Assume Nothing

Software and its interactions with hardware are complex. Dont assume one technique is faster than another; time both. Within GDI, some APIs do more work than others, and there are sometimes multiple ways to do a single operation--not all techniques will be the same speed.

Remember the old software development adage: 90% of your time is spent executing 10% of the code. If you can find the 10% through profiling and optimize it, your application will be noticeably faster.

Timing results may depend on the runtime platform. An applications performance on your development machine may be significantly different from its performance on a different runtime machine. For absolute maximum speed, implement a variety of algorithms, time them at runtime or at installation, and choose code paths accordingly. If you choose to time at installation, remember that changes to video drivers and hardware configuration after your application has been installed can have a significant effect on runtime speed.

5. Dont Stretch

Stretching a [WinGBitmap](#) requires more work than just blting it. If you must stretch, stretching by factors of 2 will be fastest.

On the other hand, if your application is pixel-bound (it spends more time writing pixels to the bitmap than it does blting), it may be faster to stretch a small [WinGBitmap](#) to a larger window than it is to fill and blt a [WinGBitmap](#) with the same dimensions as the window. Your application can respond to the [WM_GETMINMAXINFO](#) message to restrict the size of your window if you dont want to deal with this problem.

4. Dont Blt

The fastest code is the code that isnt called. Blt the smallest area possible as seldom as possible. Of course, figuring out the smallest area to blt might take longer than just blting a larger area. For example, a dirty rectangle sprite system could use complex algorithms to calculate the absolute minimum rectangles to update, but it might spend more time doing this than just blting the union of the dirty areas. The runtime environment can affect which method is faster. Again, time it to make sure.

3. Dont Clip

Selecting GDI clip regions into the destination DC or placing windows (like floating tool bars) over the destination DC can slow the blt speed.

Clip regions may seem like a good way to reduce the number of pixels actually sent to the screen, but someone has to do the work. As number 4 and number 7 discuss above, you may be better off doing the work yourself rather than using GDI.

An easy way to test your applications performance when clipped is to start the CLOCK.EXE program supplied with Windows. Set it to Always On Top and move it over your client area.

2. Use an Identity Palette

WinGBitmaps without [identity palettes](#) require a color translation per pixel when blted. Nuff said.

See the [Using an Identity Palette](#) article for specific information about what identity palettes are, how they work, and how you can use them.

1. Use the Recommended DIB Format

WinG adapts itself to the hardware available at runtime to achieve optimum performance on every platform. Every hardware and software combination can be different, and the best way to guarantee the best blt performance is to use the DIB parameters returned by [WinGRecommendDibFormat](#) in calls to [WinGCreateBitmap](#). If you do this, remember that your code must support both [bottom-up](#) and [top-down](#) DIB formats. See the [DIB Orientation](#) article for more information on handling these formats.

$$pPixelXY = \text{DibAddr} + (\text{DibHeight} - 1 - Y) * \text{DibWidthBytes} + X$$

where DibAddr is the base address of the DIB, DibHeight is the height of the DIB, lpBmiHeader is a pointer to a [BITMAPINFOHEADER](#) describing the DIB, and DibWidthBytes is the DWORD-aligned offset of bytes in memory from any X in one scanline to any X in the next scanline.

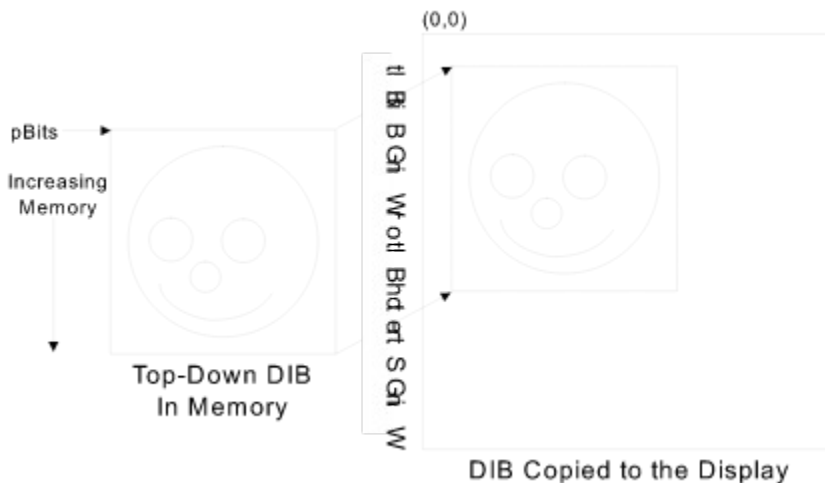
Top-Down DIBs

Another kind of DIB, called a top-down DIB, is stored with the same orientation as most device-dependent bitmaps: the first scanline in memory is the top of the image. Top-down DIBs are identified by a negative biHeight entry in their [BITMAPINFOHEADER](#) structures.

Sometimes, WinG can greatly improve the speed of a DIB-to-screen copy by using a top-down DIB because it can avoid inverting the DIB to a device-dependent format. When this is the case, [WinGRecommendDIBFormat](#) will return a negative value in the biHeight field of the passed [BITMAPINFOHEADER](#) structure.

If you are writing custom DIB drawing routines, you will have to handle top-down DIBs for best performance because there is a good chance that WinG will recommend them with [WinGRecommendDibFormat](#).

[WinGStretchBlt](#) and [WinGBitBlt](#) recognize top-down DIBs and handle them correctly, but **Windows 3.1 functions such as StretchDIBits and SetDIBitsToDevice will not work properly with top-down DIBs unless you intentionally mirror the image.**



Top-Down DIBs are copied directly to the display

For an 8-bit top-down DIB, the memory address of the pixel (X, Y) can be found with this equation:

$$\text{PixelAddr} = \text{DibAddr} + Y * \text{DibWidthBytes} + X$$

where DibAddr is the base address of the DIB and DibWidthBytes is the DWORD-aligned offset of bytes in memory from the beginning of one scanline to the next.

The [PALANIM](#) sample application (in the SAMPLES\PALANIM subdirectory of the WinG development kit) includes a routine to draw horizontal lines into a DIB. To do this, it determines the orientation of the target DIB and performs its calculations accordingly.

The [DOGGIE](#) sample application (in the SAMPLES\DOGGIE subdirectory of the WinG development kit) includes a routine to copy one DIB into another with a transparent color. The assembly function that does this also behaves well with both DIB orientations.

Using an Identity Palette

The Windows Palette Manager, described in depth in Ron Gerys technical article [The Palette Manager: How and Why](#) (see the [Further Reading](#) section for details) arbitrates conflicts between Windows applications vying for color entries in a single hardware palette (known as the [system palette](#)). It gives each application its own virtual 256-color palette, called a [logical palette](#), and translates entries in the [logical palette](#) to entries in the [system palette](#) as they are needed for blitting images to the screen.

An [identity palette](#) is a [logical palette](#) which exactly matches the current [system palette](#). An [identity palette](#) does not require translation of palette entries, so using an [identity palette](#) can drastically improve the speed with which you can blt WinGDCs to the screen.

The WinG [Halftone Palette](#) is an [identity palette](#). This article describes how to create your own identity palettes for maximum WinG blt speed.

Static Colors

The Palette Manager reserves a number of colors in the palette, called the [static colors](#), which it uses to draw system elements such as window captions, menus, borders, and scroll bars. An [identity palette](#) must include the static colors in the appropriate palette entries.

The display driver defines the actual RGB values of the [static colors](#), so they must always be determined at run time. The [GetSystemPaletteEntries](#) will retrieve the colors currently in the [system palette](#), and you can isolate the [static colors](#) using the [SIZEPALETTE](#) and [NUMCOLORS](#) capability indices with [GetDeviceCaps](#) and a little knowledge of how the Palette Manager works.

The [static colors](#) are split in half and stored at either end of the [system palette](#). If there are $nColors$ possible entries in the [system palette](#) and there are $nStaticColors$ static colors, then the static colors will be found in entries 0 through $nStaticColors/2 - 1$ and entries $nColors - nStaticColors/2$ through $nColors-1$ in the [system palette](#). Typically, there are 20 static colors, found in indices 0-9 and 246-255 of a 256-color palette. The [peFlags](#) portion of these [PALETTEENTRY](#) structures must be set to zero.

The [SetSystemPaletteUse](#) API turns use of the [static colors](#) on and off for the system. Using [SYSPAL_STATIC](#), 20 entries will be reserved in the palette. [SYSPAL_NOSTATIC](#) reserves only 2 entries, which must be mapped to black and white. See the [Accessing a Full Palette Using SYSPAL_NOSTATIC](#) article for more information.

Other Colors

The remaining non-static colors in the [logical palette](#) may be defined by the application, but they must be marked as [PC_NOCOLLAPSE](#) (see the [PALETTEENTRY](#) documentation for a description) to ensure an identity palette.

A palette containing the [static colors](#) in the appropriate entries with the remaining entries marked [PC_NOCOLLAPSE](#), selected and realized into a DC, becomes an [identity palette](#). Because no translation to the [system palette](#) is required, the Palette Manager can step aside gracefully and leave you to achieve maximum blt bandwidth.

If your palette contains duplicates of the high-intensity [static colors](#) you need to set the duplicate entries to [PC_RESERVED](#) so GDI doesn't map the upper colors in your logical palette into those slots.

Creating an Identity Palette

The [CreateIdentityPalette\(\)](#) function below shows how to create an identity palette from an array of [RGBQUAD](#) structures. Before you realize an identity palette for the first time, it may be a good idea to

clear the system palette by realizing a completely black palette, as the `ClearSystemPalette()` function below does. This will ensure that palette-managed applications executed before your application will not affect the identity mapping of your carefully constructed palette.

To make sure that you have successfully created and are using an identity palette, you can tell WinG to send debugging messages to the standard debug output, as described in the Debugging With WinG article.

The PALANIM sample (in the `SAMPLES\PALANIM` subdirectory of the WinG development kit) uses these routines to create a 256-entry identity palette filled with a wash of color.

[Click Here](#) to copy the `CreateIdentityPalette()` code sample to the clipboard.

[Click Here](#) to copy the `ClearSystemPalette()` code sample to the clipboard.

```
HPALETTE CreateIdentityPalette(RGBQUAD aRGB[], int nColors)
{
    int i;
    struct {
        WORD Version;
        WORD NumberOfEntries;
        PALETTEENTRY aEntries[256];
    } Palette =
    {
        0x300,
        256
    };

    /*** Just use the screen DC where we need it
    HDC hdc = GetDC(NULL);

    /*** For SYSPAL_NOSTATIC, just copy the color table into
    /*** a PALETTEENTRY array and replace the first and last entries
    /*** with black and white
    if (GetSystemPaletteUse(hdc) == SYSPAL_NOSTATIC)
    {
        /*** Fill in the palette with the given values, marking each
        /*** as PC_NOCOLLAPSE
        for(i = 0; i < nColors; i++)
        {
            Palette.aEntries[i].peRed = aRGB[i].rgbRed;
            Palette.aEntries[i].peGreen = aRGB[i].rgbGreen;
            Palette.aEntries[i].peBlue = aRGB[i].rgbBlue;
            Palette.aEntries[i].peFlags = PC_NOCOLLAPSE;
        }

        /*** Mark any unused entries PC_NOCOLLAPSE
        for (; i < 256; ++i)
        {
            Palette.aEntries[i].peFlags = PC_NOCOLLAPSE;
        }

        /*** Make sure the last entry is white
        /*** This may replace an entry in the array!
```

```

Palette.aEntries[255].peRed = 255;
Palette.aEntries[255].peGreen = 255;
Palette.aEntries[255].peBlue = 255;
Palette.aEntries[255].peFlags = 0;

/** And the first is black
/** This may replace an entry in the array!
Palette.aEntries[0].peRed = 0;
Palette.aEntries[0].peGreen = 0;
Palette.aEntries[0].peBlue = 0;
Palette.aEntries[0].peFlags = 0;
}
else
/** For SYSPAL_STATIC, get the twenty static colors into
/** the array, then fill in the empty spaces with the
/** given color table
{
    int nStaticColors;
    int nUsableColors;

    /** Get the static colors from the system palette
    nStaticColors = GetDeviceCaps(hdc, NUMCOLORS);
    GetSystemPaletteEntries(hdc, 0, 256, Palette.aEntries);

    /** Set the peFlags of the lower static colors to zero
    nStaticColors = nStaticColors / 2;
    for (i=0; i<nStaticColors; i++)
        Palette.aEntries[i].peFlags = 0;

    /** Fill in the entries from the given color table
    nUsableColors = nColors - nStaticColors;
    for (; i<nUsableColors; i++)
    {
        Palette.aEntries[i].peRed = aRGB[i].rgbRed;
        Palette.aEntries[i].peGreen = aRGB[i].rgbGreen;
        Palette.aEntries[i].peBlue = aRGB[i].rgbBlue;
        Palette.aEntries[i].peFlags = PC_NOCOLLAPSE;
    }

    /** Mark any empty entries as PC_NOCOLLAPSE
    for (; i<256 - nStaticColors; i++)
        Palette.aEntries[i].peFlags = PC_NOCOLLAPSE;

    /** Set the peFlags of the upper static colors to zero
    for (i = 256 - nStaticColors; i<256; i++)
        Palette.aEntries[i].peFlags = 0;
}

/** Remember to release the DC!
ReleaseDC(NULL, hdc);

/** Return the palette
return CreatePalette((LOGPALETTE *)&Palette);
}

```

```

void ClearSystemPalette(void)
{
    /*** A dummy palette setup
    struct
    {
        WORD Version;
        WORD NumberOfEntries;
        PALETTEENTRY aEntries[256];
    } Palette =
    {
        0x300,
        256
    };

    HPALETTE ScreenPalette = 0;
    HDC ScreenDC;
    int Counter;

    /*** Reset everything in the system palette to black
    for(Counter = 0; Counter < 256; Counter++)
    {
        Palette.aEntries[Counter].peRed = 0;
        Palette.aEntries[Counter].peGreen = 0;
        Palette.aEntries[Counter].peBlue = 0;

        Palette.aEntries[Counter].peFlags = PC_NOCOLLAPSE;
    }

    /*** Create, select, realize, deselect, and delete the palette
    ScreenDC = GetDC(NULL);
    ScreenPalette = CreatePalette((LOGPALETTE *)&Palette);
    if (ScreenPalette)
    {
        ScreenPalette = SelectPalette(ScreenDC,ScreenPalette,FALSE);
        RealizePalette(ScreenDC);
        ScreenPalette = SelectPalette(ScreenDC,ScreenPalette,FALSE);
        DeleteObject(ScreenPalette);
    }
    ReleaseDC(NULL, ScreenDC);
}

```

Palette Animation With WinG

Palette animation creates the appearance of motion in an image by modifying entries in the system palette, resulting in color changes in the displayed image. Carefully arranged and animated palette entries can produce motion effects such as running water, flowing lava, or even motion of an object across the screen.

The Windows AnimatePalette function replaces entries in the logical palette and the system palette. The app does not need to re-realize the palette after a call to AnimatePalette.

Because every DIB and WinGBitmap has an associated color table which is translated to the system palette when the image is copied to the screen, DIBs blt'd after the palette is animated will not appear animated because their colors are translated to the new palette.

The Using an Identity Palette article discusses the creation of an identity palette which removes the need for color translation when blt'ing. If a palette animating application went through the trouble to create the identity palette, it should maintain the identity mapping between the palette and the WinGDC by matching the WinGBitmap color table to the animated palette before blt'ing. To do this, use WinGSetDibColorTable to keep the WinGBitmap color table synchronized with changes in the system palette.

Remember that any entries in a palette which are to be animated must be marked with the PC_RESERVED flag. PC_RESERVED is a superset of PC_NOCOLLAPSE flag, so these entries can be used in an identity palette.

The PALANIM sample (in the SAMPLES\PALANIM subdirectory of the WinG development kit) performs a simple palette animation with an identity palette, making sure to update the WinGDC color table to match the palette before it blt's using the following code, which copies the current logical palette (hpalApp) into the color table of the WinGDC (hdcOffscreen). Of course, if you create the palette yourself from an array of colors, there will be no need to call GetPaletteEntries because you could update the color table from the array you already have in memory. Also, in a palette animation that does not animate the complete palette, an application would not need to modify the entire palette and color table, as this code snippet does:

```
int i;
PALETTEENTRY aPalette[256];
RGBQUAD aPaletteRGB[256];

/***/ BEFORE BLTING, match the DIB color table to the
/***/ current palette to match the animated palette
GetPaletteEntries(hpalApp, 0, 256, aPalette);
/***/ Alas, palette entries are r-g-b, rgbquads are b-g-r
for (i=0; i<256; ++i)
{
    aPaletteRGB[i].rgbRed = aPalette[i].peRed;
    aPaletteRGB[i].rgbGreen = aPalette[i].peGreen;
    aPaletteRGB[i].rgbBlue = aPalette[i].peBlue;
    aPaletteRGB[i].rgbReserved = 0;
}
WinGSetDIBColorTable(hdcOffscreen, 0, 256, aPaletteRGB);
```


Accessing a Full Palette Using SYSPAL_NOSTATIC

The Palette Manager usually reserves twenty static colors in the palette for use in drawing captions, menus, text, scroll bars, window frames, and other system elements. These static colors ensure a common color scheme across all applications, but this leaves only 236 palette entries available to each application. A Windows graphics application requiring a full palette of 256 colors has two options, outlined here.

The first option is to incorporate the static colors into the palette at runtime, knowing that the RGB values of the colors may change slightly from display driver to display driver. This means that the palette will vary slightly when the application runs on different platforms, but it ensures the consistent look and feel between the application and coexisting applications in the system.

The static colors are defined as follows:

<u>Index</u>	Color	<u>Index</u>	Color
0	Black	246	Cream
1	Dark Red	247	Light Gray
2	Dark Green	248	Medium Gray
3	Dark Yellow	249	Red
4	Dark Blue	250	Green
5	Dark Magenta	251	Yellow
6	Dark Cyan	252	Blue
7	Light Gray	253	Magenta
8	Money Green	254	Cyan
9	Sky Blue	255	White

If you can accept the limitation of including these colors in your palette and determining their exact RGB values at runtime (using GetSystemPaletteEntries), you can skip the rest of this article.

The second option is to tell the Window Manager to make 18 of the twenty static colors available to the application, with entry 0 remaining black and entry 255 remaining white. However, choosing to control those palette entries means you'll have some more intimate relations with the Palette Manager.

To change the use of the static colors in the system palette, you use the SetSystemPaletteUse API, passing either SYSPAL_STATIC or SYSPAL_NOSTATIC. Setting the palette use to SYSPAL_NOSTATIC gives you access to palette entries 1 through 254. Your palette must map entry 0 to RGB(0, 0, 0) and entry 255 to RGB(255, 255, 255), but black and white are standard in most palettes anyway.

Ordinarily, Windows uses entries 0-9 and 246-255 to draw captions, borders, menus, and text, and it will continue to do so after you've changed the RGB values of those palette entries unless you tell it to do otherwise. If you do not inform the operating system of your changes, your application and all others in the system will become very messy and your application will be condemned by its peers as unfriendly.

You want your application to be friendly to the operating system and to the other active applications. You can handle this in two ways: you can make your application a full-screen window with no controls, thereby taking over the entire screen and the full palette, or you can tell the operating system to use different palette entries to draw its captions, borders, menus, and text so that other visible windows do not appear completely strange. In either case, you must restore the static colors when your application becomes inactive or exits.

The following procedure handles the switch between SYSPAL_STATIC and SYSPAL_NOSTATIC for you, managing the mapping and remapping of the system colors for you through the Windows functions GetSysColor and SetSysColors. It stores the current mapping of the system colors before switching to SYSPAL_NOSTATIC mode and restores them after switching back to SYSPAL_STATIC mode.

To use the AppActivate() function in an application, call AppActivate((BOOL)wParam) in response to a WM_ACTIVATEAPP message and call AppActivate(FALSE) before exiting to restore the system colors. This will set the system palette use and remap the system colors when your application is activated or deactivated.

The PALANIM sample (in the SAMPLES\PALANIM subdirectory of the WinG development kit) uses this function to take over the static colors at run time and clean up before it exits.

[Click Here](#) to copy this code sample to the clipboard.

```
#define NumSysColors (sizeof(SysPalIndex)/sizeof(SysPalIndex[1]))
#define rgbBlack RGB(0,0,0)
#define rgbWhite RGB(255,255,255)
```

```
/** These are the GetSysColor display element identifiers
```

```
static int SysPalIndex[] = {
    COLOR_ACTIVEBORDER,
    COLOR_ACTIVECAPTION,
    COLOR_APPWORKSPACE,
    COLOR_BACKGROUND,
    COLOR_BTNFACE,
    COLOR_BTNSHADOW,
    COLOR_BTNTEXT,
    COLOR_CAPTIONTEXT,
    COLOR_GRAYTEXT,
    COLOR_HIGHLIGHT,
    COLOR_HIGHLIGHTTEXT,
    COLOR_INACTIVEBORDER,
    COLOR_INACTIVECAPTION,
    COLOR_MENU,
    COLOR_MENUTEXT,
    COLOR_SCROLLBAR,
    COLOR_WINDOW,
    COLOR_WINDOWFRAME,
    COLOR_WINDOWTEXT
};
```

```
/** This array translates the display elements to black and white
```

```
static COLORREF MonoColors[] = {
    rgbBlack,
    rgbWhite,
    rgbWhite,
    rgbWhite,
    rgbWhite,
    rgbBlack,
    rgbBlack,
    rgbBlack,
    rgbBlack,
    rgbBlack,
    rgbBlack,
    rgbWhite,
    rgbWhite,
    rgbWhite,
    rgbWhite,
    rgbBlack,
    rgbWhite,
    rgbWhite,
```

```

    rgbBlack,
    rgbBlack
};

/** This array holds the old color mapping so we can restore them
static COLORREF OldColors[NumSysColors];

/** AppActivate sets the system palette use and
/** remaps the system colors accordingly.
void AppActivate(BOOL fActive)
{
    HDC hdc;
    int i;

    /** Just use the screen DC
    hdc = GetDC(NULL);

    /** If the app is activating, save the current color mapping
    /** and switch to SYSPAL_NOSTATIC
    if (fActive && GetSystemPaletteUse(hdc) == SYSPAL_STATIC)
    {
        /** Store the current mapping
        for (i=0; i<NumSysColors; i++)
            OldColors[i] = GetSysColor(SysPalIndex[i]);

        /** Switch to SYSPAL_NOSTATIC and remap the colors
        SetSystemPaletteUse(hdc, SYSPAL_NOSTATIC);
        SetSysColors(NumSysColors, SysPalIndex, MonoColors);
    }
    else if (!fActive && GetSystemPaletteUse(hdc) == SYSPAL_NOSTATIC)
    {
        /** Switch back to SYSPAL_STATIC and the old mapping
        SetSystemPaletteUse(hdc, SYSPAL_STATIC);
        SetSysColors(NumSysColors, SysPalIndex, OldColors);
    }

    /** Be sure to release the DC!
    ReleaseDC(NULL,hdc);
}

```

Debugging WinG Applications

WinG will report runtime errors and helpful debugging messages through standard Windows debug output devices (the serial port or applications such as DBWIN.EXE) if you so desire. If you want WinG to send error messages to the debug output, make sure the following entry appears in your WIN.INI file. If there is already a [WinG] section (there will be if WinG has previously profiled your display), just add the Debug=1 line under that heading:

```
[WinG]
Debug=1
```

If you specifically do not want debug messages to appear, set this to:

```
[WinG]
Debug=0
```

If neither debug level is specified in the [WinG] section of your WIN.INI file, debugging will be turned ON if you're using the Windows debug kernel and OFF if you're using the Windows retail kernel. Setting the Debug level explicitly in your WIN.INI will always override this default behavior.

WinG can also provide you with a detailed log of palette translations between the color table of a WinGBitmap and the logical palette and system palette. This will help to identify discrepancies in the palette which prevent WinG from using faster blts with an identity palette. To receive these palette notifications through the debug output, add the following line to the [WinG] section of win.ini:

```
DebugPalette = 1
```

Debugging WinG applications is no different than debugging normal Windows applications, but there are some minor known problems and workarounds for the the following debuggers:

Borland

There are known problems with debugging WinG applications using Turbo Debugger for Windows. If you have problems debugging with TDW, try running one of the samples first and leave it minimized so WinG.DLL will already be in memory when you debug your application.

Microsoft

No known problems.

Symantec

No known problems.

Watcom

No known problems.

Compiling WinG Applications

BETA: This article is not yet complete.

Win32s allows access to 32-bit code and a subset of the 32-bit Windows APIs under 16-bit versions of Windows. There are some extra things to consider when compiling and debugging Win32s applications.

The easiest environment for developing and debugging Win32 programs are, obviously, the 32-bit versions of Windows. Debugging Win32s programs while running 16 bit Windows can be very difficult. Because WinG supports Windows 4.0 and NT 3.5, programmers can develop and debug their application in a 32-bit environment, running under Win32s only for run-time testing.

Compiling and linking for Win32s can be tricky with some compilers. Several major compilers require various incantations to successfully build a Win32s application. Hopefully, the following hints will aid in the successful compilation and linking of WinG applications using these compilers.

The WinG32.lib file in the WinG SDK is a Common Object File Format (COFF) library file. Most non-Microsoft Win32 compilers support only Object-Module Format (OMF) library files, so you may have problems linking to WinG32 functions. If you encounter link problems, first see if your compiler has an import librarian, a program that creates a library file from a DLL. Run this program on WinG32.dll and try linking with the generated library file. If this doesn't work or you don't have an import librarian, try explicitly importing the functions in your .def file. As a last resort you can dynamically link to WinG32 using [LoadLibrary](#) and [GetProcAddress](#).

Borland

Run `implib` on `WinG32.dll` or modify the `.def` file.

Microsoft

No known problems.

Symantec

Run `implib` on `WinG32.dll` or modify the `.def` file.

Watcom

The Watcom linker will have trouble linking to the `wing32.lib` export file included with the WinG Development Kit. This export file lists undecorated names, using the conventions established for Alpha, MIPS, and x86 cross-assembly. To create a new `wing32.lib` file linkable with the Watcom tools, run `wlib` on `win32.dll` as follows:

```
wlib wing32 @wing32.lbc
```

where `wing32.lbc` is a text file containing the following description of the WinG functions:

```
++'_WinGBitBlt'. 'WING32.DLL'..WinGBitBlt
++'_WinGCreateBitmap'. 'WING32.DLL'..WinGCreateBitmap
++'_WinGCreateDC'. 'WING32.DLL'..WinGCreateDC
++'_WinGCreateHalftoneBrush'. 'WING32.DLL'..WinGCreateHalftoneBrush
++'_WinGCreateHalftonePalette'. 'WING32.DLL'..WinGCreateHalftonePalette
```

```
++'_WinGGetDIBColorTable'. 'WING32.DLL'..WinGGetDIBColorTable  
++'_WinGGetDIBPointer'. 'WING32.DLL'..WinGGetDIBPointer  
++'_WinGRecommendDIBFormat'. 'WING32.DLL'..WinGRecommendDIBFormat  
++'_WinGSetDIBColorTable'. 'WING32.DLL'..WinGSetDIBColorTable  
++'_WinGStretchBlt'. 'WING32.DLL'..WinGStretchBlt
```

DISPDIB and WinG

BETA: This article is not yet complete.

DISPDIB provides direct VGA hardware access under Windows through the DisplayDib function, which bypasses the standard Windows video driver architecture and gives control of the hardware to the calling application. Although DISPDIB has nothing to do with WinG, game developers may find it to be a workable alternative to creating full-blown windowed applications.

DisplayDib was originally intended to display single 256-color bitmaps in 320x200 or 320x240 modes until a key or mouse button was pressed, but you can take over the video indefinitely by using the DISPDIB_NOWAIT flag or the DISPDIB_BEGIN and DISPDIB_END flags. While DISPDIB is enabled, the calling application has direct access to the VGA hardware registers.

While it is active, DISPDIB disables the Windows video driver. GDI has no effect on the screen, but the other Windows system components remain active. During the time between DISPDIB_BEGIN and DISPDIB_END calls, the application receives messages as usual, including keyboard, timer, and mouse messages, and Windows memory management, networking, and other system services are still available.

Note that mouse coordinates received by the application will be in the coordinate system of the display driver. That is, if an application running in a 1024x768 Windows session switches to a 320x200 full-screen mode using DISPDIB, the system continues to return mouse coordinates as though the screen were 1024x768.

An application using DISPDIB must be the active application when it calls DisplayDib.

Frequently Asked Questions

BETA: This article is not yet complete. If you have questions that you would like to see answered here or end up searching through this help file for an answer, send mail to wingbug@microsoft.com and ask us to add it to the FAQ!

Q:

A:

Shipping a Product With WinG

Microsoft grants you the royalty-free right to distribute any application you create using WinG, along with the WinG runtime support files listed below.

If your application uses WinG, you will have to copy the WinG runtime files into the \SYSTEM subdirectory of the Windows directory if WinG has not been previously installed on the target system. The following files should be installed on the users system:

WING.DLL
WING32.DLL
WINGDE.DLL
WINGDIB.DRV
WINGPAL.WND
DVA.386

If your installation process copies dva.386 to the users machine, the following line should be added to the [386Enh] section of the system.ini file, after which the user should reboot Windows:

```
device=dva.386
```

The Windows Software Development Kit includes the Setup Toolkit for Windows, which allows you to create and run setup scripts for installing Windows applications. Documentation for the toolkit comes with the Windows SDK and is also available through the Microsoft Developer Relations Group and the Microsoft Developer Network CD.

The WinG Development Kit setup program installs the WinG runtime files using Microsoft setup exactly as they should be installed on a target users system. Look at the WING.MST script on the WinG installation diskette to see how this is done.

Code Samples

The WinG development kit contains a variety of code samples to help you develop fast applications quickly using WinG.

Snippets

The following code samples appear in this help file:

Setting up an [off-screen buffer](#) with WinG.

Calculating the [memory address of a scanline](#) in a WinGBitmap.

[Creating an Identity Palette](#).

[Clearing the System Palette](#).

Maximizing palette availability using the [SYSPAL_NOSTATIC](#) setting.

[Copying a logical palette](#) to a WinGBitmap color table.

Matching an [RGB color to a halftone palette](#) entry.

Sample Applications

The WinG Development Kit also contains source code for several sample applications, installed in the \SAMPLES subdirectory. The following applications are available:

[DOGGIE](#) allows the user to drag a sprite around the screen with the mouse, demonstrating off-screen composition, dirty rectangle animation, and custom blt routines. Includes source code for a sample 8-bit DIB to 8-bit DIB blt with one transparent color.

[CUBE](#) displays a halftoned rotating cube in a window that the user can manipulate with the mouse. It demonstrates off-screen composition, double-buffering, and using the halftone palette and halftone brushes with GDI to draw into a WinGDC.

[TIMEWING](#) tests and compares blt speeds of existing GDI functions with the [WinGStretchBlt](#) function. This sample will give you an idea of how WinG will compare to standard GDI blts.

[HALFTONE](#) converts 24-bit RGB DIBs to 8-bit DIBs by dithering them to the [WinG Halftone Palette](#). The source code implements a standard 8x8 dither and color matching to the [halftone palette](#).

[PALANIM](#) performs simple palette animation with an [identity palette](#) using WinG. This application uses all of the sample code appearing in this help file.

Balloon Doggie Sample

The Balloon Doggie sample application, found in the SAMPLES\DOGGIE subdirectory of the WinG development kit, demonstrates a simple dirty rectangle animation system. It creates a WinGDC and a WinGBitmap, which it uses as an off-screen buffer, and uses WinGBitBlt to update the screen.

Balloon Doggie includes source code for TransparentDIBits (in TBLT.C and FAST32.ASM), a fast DIB-to-DIB blt with transparency. TransparentDIBits demonstrates the use of custom drawing routines with WinG to provide functions not present or unacceptably slow in GDI.

Note that DOGGIE.EXE requires MASM 5.1 to compile FAST32.ASM. If you do not own MASM 5.1, link to the precompiled FAST32.OBJ, included with the DOGGIE sample.

Spinning Cube Sample

The CUBE.EXE sample application, found in the SAMPLES\CUBE subdirectory of the WinG development kit, demonstrates the use of Halftoning to create the appearance of more than 256 colors on an 8-bit palletized display device. Using WinGCreateHalftonePalette and WinGCreateHalftoneBrush, the spinning cube application halftones the faces of the cube to create lighting effects.

The Spinning Cube sample uses a standard double buffering architecture using a WinGDC and a WinGBitmap. It creates a WinGDC when the application starts, then creates and selects appropriate WinGBitmaps on WM_SIZE messages to keep the off-screen buffer the same size as the windows client region.

When appropriate, the application uses the GDI Polygon function to draw into the off-screen buffer then calls WinGBitBlt to copy the buffer to the screen.

The CUBE sample uses a simple floating-point vector and camera C++ class library (in DUMB3D.HPP and DUMB3D.CPP) that can be used as a starting point by those interested in generating 3D graphics.

WinG Timing Sample

The timing sample, TIMEWING.EXE, found in the SAMPLES\TIMEWING subdirectory of the WinG development kit, times and compares the blt and stretching speeds of StretchBlt, StretchDIBits, and WinGStretchBlt. The application provides a summary you can use to compare the speeds of these techniques on various video configurations and a framework you can use for your own timing tests.

On most platforms, WinGStretchBlt will perform favorably in comparison to StretchBlt and will blow StretchDIBits away. SetDIBitsToDevice and StretchDIBits are essentially the same API, so this function is not timed. WinGStretchBlt and WinGBitBlt will perform the same if the stretch ratio is 1 to 1, as will StretchBlt and BitBlt.

Note that StretchDIBits and WinGStretchBlt operate on device-independent bitmaps whereas StretchBlt and BitBlt operate on device-specific bitmaps, which require no translation and can sometimes be stored in the local memory of the graphics card itself. For this reason, StretchBlt usually runs at speeds approaching video memory bandwidth, which is the target speed for WinGStretchBlt.

Timewing.exe can be built as a Win32 app by compiling with the timewing.m32 makefile. You may need to modify timewing.m32 for your compiler environment.

Also note that some drivers cheat on their BitBlts by keeping the last blted image in card memory. If the image is blted again, the card uses the cached image instead of the memory image. This can result in misleading performance benchmarks unless a different image is blted at each frame. This is not the same as a card with device bitmaps, which is a completely legal way to improve display performance.

WinG Halftoning Sample

HALFTONE.EXE, found in the SAMPLES\HALFTONE subdirectory of the WinG development kit, dithers 24-bit DIBs to the [WinG Halftone Palette](#) using an 8x8 ordered dither.

The main function, DibHalftoneDIB in HALFTONE.C, does the real work in the dithering. The process of calculating an ordered dither is too complex to describe here, but a description of the techniques involved can be found in Computer Graphics: Principles and Practice by Foley, van Dam, Feiner, and Hughes. See the [Further Reading](#) article for more information on this book.

The aWinGHalftoneTranslation array found in HTTABLES.C converts a 2.6-bit-per-pixel computed halftone index into an entry in the halftone palette. To calculate the nearest match of an RGB color to the halftone palette, HALFTONE uses the following formula:

```
HalftoneIndex = (Red / 51) + (Green / 51) * 6 + (Blue / 51) * 36;  
HalftoneColorIndex = aWinGHalftoneTranslation [HalftoneIndex];
```

See also the documentation for the [WinGCreateHalftoneBrush](#) function and the [Halftoning With WinG](#) article.

WinG Palette Animation Sample

The PALANIM.EXE application, found in the SAMPLES\PALANIM subdirectory of the WinG development kit, performs simple palette animation using [AnimatePalette](#) and [WinGSetDIBColorTable](#) as described in the [Palette Animation With WinG](#) article.

PALANIM gives the user the option of using the [static colors](#) in the palette to create a 254-color ramp or a 236-color ramp in an [identity palette](#) for fast blitting.

The PALANIM sample uses the [code samples](#) found in this help file to perform all of its WinG functions.

WinG Programmers Reference

All of the source code, applications, and information included in the WinG development kit is provided as is without warranty of any kind, either expressed or implied, including but not limited to the implied warranties of merchantability and/or fitness for a particular purpose.

You have a royalty-free right to use, modify, reproduce and distribute the Sample Files (and/or any modified version) in any way you find useful, provided that you agree that Microsoft has no warranty obligations or liability for any Sample Application Files which are modified.

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This is a standard Windows 3.1 or Win32 API, structure, or constant. Documentation can be found in the Help files installed with the Windows SDK.

This is a standard Win32 API, structure, or constant. Documentation can be found in the Help files installed with the Win32 SDK.

WinG Beta readme - Late-breaking news and known bugs

Microsoft WinG - Beta release - June 27, 1994

This file describes known bugs, gotchas, and helpful hints for the WinG Beta release. Please remember that this is a beta version and is subject to the usual Beta Disclaimers.

Reporting Bugs

The main goal of this Beta release, in addition to providing you with a solid foundation for writing great graphics-intensive Windows applications, is to flush out compatibility problems with WinG. We want to know when you encounter bugs, and want to hear suggestions and/or recommendations you have about WinG or its support files.

With this in mind, we have included WINGBUG.EXE in the WinG Beta Development Kit (in the BIN directory of the SDK), an automated tool for gathering information on your configuration for reporting bugs to the WinG development team. This tool creates a complete bug report by prompting you for information about the bug, your configuration, and the steps used to reproduce the bug. The resulting bug report text file should be sent to the wingbug@microsoft.com address, or sent to Microsoft on floppy disk.

Before reporting a bug, please be sure that it's not one we already know about by looking through the Known Bugs and Limitations section below. If there is any doubt, send the bug anyway--it's better to have a duplicate bug on file than not know about one.

Known Bugs And Limitations

The following are known problems with the beta version of WinG.

These bugs and design decisions will be fixed or resolved before the final release. Their presence here serves only as a warning to programmers coding for this release.

- WinGBitmaps must be created with full 256 entry color tables.
- WinG will assert on 8bpp non-palette devices, like the ATI Mach32 8bpp non-palette mode.
- CMACRO32.INC from the doggie sample application requires Microsoft MASM 5.1 to compile. You must specify the /NOPACKCODE option when linking segments produced with CMACRO32.INC.
- Calling WinGStretchBlt and WinGBitBlt with source coordinates outside of the source boundary can crash WinG.
- WinGBitBlt and WinGStretchBlt only support bltting from WinGDCs to the screen.
 - Several GDI APIs that should work into WinGDCs dont right now. If you discover others not on this list wed appreciate hearing about them.
 - StrechDIBits with non-1:1 ratio screws up
 - hatched brushes sometimes draw incorrectly
 - FloodFill with a NULL brush draws incorrectly

- FloodFill outside of the bounds of a WinGBitmap can flood the whole image
- PALETTE_RGBs may map differently when compared to the display
- brushes created with CreatePatternBrush fault when selected
- some drawing operations draw slightly differently than standard GDI
- DrawIcon will crash
- WinGDCs will incorrectly map non-exact matches in the color-table
- You cannot change the origin of halftone brushes.
- The sample program makefiles are named sample.mk (where sample is the name of the sample) instead of makefile because of limitations with Microsoft Setup.
- Some GP Faults within the SVGA256.DRV driver have been found. If you encounter one, please use WINGBUG.EXE and send mail to wingbug@microsoft.com.
- WinG does not unload when a GP Fault occurs. For accurate performance, be sure to unload WinG.DLL or reboot Windows after a GP Fault in a WinG application.
- WinGBitBlt and WinGStretchBlt sometimes have trouble clipping to non-rectangular clipping regions. If you encounter incorrect behavior, please use WINGBUG.EXE and send mail to wingbug@microsoft.com.
- 16-bit WinG applications will not run on Daytona Beta 1 (build 612). You must have Daytona Beta 2 (build 683) to use 16-bit WinG applications under Windows NT. 32-bit WinG applications will run on all versions of Daytona.
- Noticeable timing differences have been found while running the WinG profiler on a computer connected to a network. For accurate results, disconnect your computer from the network the first time you run a WinG application. After the profile is complete, you can plug the net in again.

A Note on Speed

WinG is designed to be the absolute fastest way to blt DIBs under Windows. The goal is to blt at memory bandwidth to the display device. In other words, we are competing with BitBlt and DOS blts, not StretchDIBits or SetDIBitsToDevice.

On most 8bpp devices, if you use the recommended DIB format (returned by WinGRecommendDIBFormat) you should get speeds comparable to BitBlt, and much faster than StretchDIBits. The timewing sample application will show you various blt speeds on your display.

The only time WinG (in its final release) will not be able to beat or match BitBlt is on some "device bitmap" drivers. These are drivers that keep HBITMAPs in video ram and use the display hardware to copy to the screen at much higher speeds than one can copy from main memory.

If you run timewing and the WinGStretchBlt performance is not as good or better than the StretchBlt case and is not much faster than the StretchDIBits case, please use WINGBUG.EXE and send a bug report to wingbug@microsoft.com. We treat performance problems as priority 1 bugs. After all, if it's not fast it's not worth using.

Thanks a lot for your participation in the WinG Beta program!

WinG API

The WinG API is a small set of functions for manipulating DIBs in the same way that device dependent bitmaps are manipulated in Windows.

WinGDCs and WinGBitmaps

WinGCreateDC

Create a new WinGDC

WinGCreateBitmap

Create a new WinGBitmap

WinGGetDIBPointer

Return the DIB pointer to a WinGBitmap

WinGRecommendDIBFormat

Recommend an optimal DIB format for memory-to-screen bits

WinGGetDIBColorTable

Return the DIB color table of a selected WinGBitmap

WinGSetDIBColorTable

Set the DIB color table of a selected WinGBitmap

Blts

WinGBitBlt

Copy a WinGDC to another DC

WinGStretchBlt

Copy a WinGDC to another DC with stretching

Halftoning

WinGCreateHalftoneBrush

Create a halftone brush

WinGCreateHalftonePalette

Create a copy of the WinG halftone palette

WING_DITHER_TYPE

Dither types for halftone brushes

WinGBitBlt

Copies an area from a specified device context to a destination device context. **WinGBitBlt** is optimized for copying WinGDCs to display DCs.

BOOL WinGBitBlt(HDC *hdcDest*, int *nXOriginDest*, int *nYOriginDest*, int *nWidthDest*, int *nHeightDest*, HDC *hdcSrc*, int *nXOriginSrc*, int *nYOriginSrc*)

Parameters

<i>hdcDest</i>	Identifies the destination device context.
<i>nXOriginDest</i>	X coordinate of the upper-left corner of the destination rectangle in MM_TEXT client coordinates.
<i>nYOriginDest</i>	Y coordinate of the upper-left corner of the destination rectangle in MM_TEXT client coordinates.
<i>nWidthDest</i>	Width of the source and destination rectangle..
<i>nHeightDest</i>	Height of the source and destination rectangle..
<i>hdcSrc</i>	Identifies the source device context.
<i>nXOriginSrc</i>	X coordinate of the upper-left corner of the source rectangle in MM_TEXT client coordinates.
<i>nYOriginSrc</i>	Y coordinate of the upper-left corner of the source rectangle in MM_TEXT client coordinates.

Return Value

The return value is non-zero if the function is successful. Otherwise, it is zero.

Comments

WinGBitBlt requires both DCs to use MM_TEXT mapping mode at the time of the call or the results may be unpredictable. At other times, any mapping mode may be used in either DC.

In the current implementation, **WinGBitBlt** will fail under Windows 3.1 and Win32s if the source DC is not an 8-bit-per-pixel WinGDC. Future implementations will allow for different pixel formats for WinGBitmaps.

Maximizing Performance

You will get the highest performance from **WinGBitBlt** if you select a WinGBitmap created from header information supplied by a call to WinGRecommendDIBFormat.

WinGBitBlt is optimized for copying WinGDCs to the screen.

Clipping can slow **WinGBitBlt** down. In general, dont select clipping regions into or blt outside the boundaries of the source or destination DCs and avoid blting to an overlapped window if possible.

See Also

[WinGStretchBlt](#) [WinGCreateDC](#) [WinGCreateBitmap](#) [WinGRecommendDIBFormat](#) [Maximizing Performance With WinG](#)

WinGCreateBitmap

Creates a WinGBitmap for the given WinGDC using the specified header information.

HBITMAP WinGCreateBitmap(HDC *hWinGDC*, BITMAPINFO far **pHeader*, void far *far **ppBits*)

Parameters

<i>hWinGDC</i>	Identifies the WinG device context.
<i>pHeader</i>	Points to a BITMAPINFO structure specifying the width, height, and color table for the new WinGBitmap.
<i>ppBitsr</i>	If not 0, points to a pointer to receive the address of the new WinGDC DIB surface.

Return Value

Returns a handle to the new WinGBitmap DIB surface or 0 if it is unsuccessful.

Comments

Currently, under Windows 3.1 and Win32s, **WinGCreateBitmap** will only create 8-bit-per-pixel surfaces.

If *ppBits* is 0, the address of the newly created bitmap will not be returned. [WinGGetDIBPointer](#) will also return this information.

pHeader must point to enough memory to hold a [BITMAPINFOHEADER](#) and a complete color table of RGBQUAD entries. The *biClrUsed* field of the [BITMAPINFOHEADER](#) specifies the number of colors in the color table; if it is zero, the maximum number of colors according to *biBitCount* are used if *biBitCount* is less than 24. For example, if *biBitCount* is 8 and *biClrUsed* is 0, 256 palette entries are expected. See the [BITMAPINFOHEADER](#) description in the Windows 3.1 SDK Reference for more information.

When an application has finished using a WinGBitmap, it should select the bitmap out of its WinGDC and remove the bitmap by calling [DeleteObject](#).

The pointer to the WinGBitmap DIB surface returned by **WinGCreateBitmap** must not be freed by the caller. The allocated memory will be freed by a call to [DeleteObject](#).

WinGCreateBitmap uses *pHeader* and the subsequent color table to create the drawing surface. WinG ignores the *biClrImportant*, *biXPelsPerMeter*, *biYPelsPerMeter*, and *biSizeImage* fields. The current version of WinG expects *biCompression* to be BI_RGB.

If the *biHeight* field of the passed [BITMAPINFOHEADER](#) is negative, **WinGCreateBitmap** will create a [top-down](#) DIB as the bitmap surface. See the article on [DIB Orientation](#) for a discussion of [top-down](#) and [bottom-up](#) DIBs.

An [HBITMAP](#) can only be selected into one device context at a time, and a device context can only have a single [HBITMAP](#) selected in at a time.

Maximizing Performance

To create a WinGBitmap that will maximize [WinGBitBlit](#) performance, use [WinGRecommendDIBFormat](#) to fill in the entries of *pHeader* before calling **WinGCreateBitmap**, remembering to modify the height and width to suit your needs.

Larger WinGBitmaps take longer to blt to the screen. Also, if the screen DC is clipped, for example by an overlapping window or by a selected clip region, the WinGDC will take longer to blt to the screen.

Using an identity palette that exactly matches the WinGBitmaps color table will greatly increase performance.

Example

The following code fragment shows how an application could create a WinGDC with an optimal 100x100 WinGBitmap selected for drawing, then delete it when it is no longer needed. Note that the WinGBitmap will initially have garbage in its color table--be sure to call WinGSetDIBColorTable before using the WinGDC.

The PALANIM sample (in the SAMPLES\PALANIM subdirectory of the WinG development kit) uses these routines, modified to create a 256x256 WinGDC, to allocate and free its drawing buffer.

Click Here to copy this code sample to the clipboard.

```

    HBITMAP ghBitmapMonochrome = 0;

    HDC Create100x100WinGDC(void)
    {
        HDC hWinGDC;
        HBITMAP hBitmapNew;
        struct {
            BITMAPINFOHEADER InfoHeader;
            RGBQUAD ColorTable[256];
        } Info;
        void far *pSurfaceBits;

        // Set up an optimal bitmap
        if (WinGRecommendDibFormat((BITMAPINFO far *)&Info) == FALSE)
            return 0;

        // Set the width and height of the DIB but preserve the
        // sign of biHeight in case top-down DIBs are faster
        Info.InfoHeader.biHeight *= 100;
        Info.InfoHeader.biWidth = 100;

        // Create a WinGDC and Bitmap, then select away
        hWinGDC = WinGCreateDC();
        if (hWinGDC)
        {
            hBitmapNew = WinGCreateBitmap(hWinGDC,
                (BITMAPINFO far *)&Info, &pSurfaceBits);
            if (hBitmapNew)
            {
                ghBitmapMonochrome = (HBITMAP)SelectObject(hWinGDC,
                    hBitmapNew);
            }
            else
            {
                DeleteDC(hWinGDC);
                hWinGDC = 0;
            }
        }
    }
}
```

```
    return hWinGDC;
}

void Destroy100x100WinGDC(HDC hWinGDC)
{
    HBITMAP hBitmapOld;

    if (hWinGDC && ghBitmapMonochrome)
    {
        // Select the stock 1x1 monochrome bitmap back in
        hBitmapOld = (HBITMAP)SelectObject(hWinGDC,
            ghBitmapMonochrome);
        DeleteObject(hBitmapOld);
        DeleteDC(hWinGDC);
    }
}
```

See Also

[WinGCreateDC](#) [WinGRecommendDIBFormat](#) [CreateBitmapCreateCompatibleBitmap](#) [BITMAPINFO](#)
[BITMAPINFOHEADER](#) [WinGGetDIBPointer](#) [CreateDIBSection](#) [Code Samples](#) [Off-screen Drawing](#)
[With WinG](#) [Maximizing Performance With WinG](#)

WinGCreateDC

Creates a WinG device context with the stock 1x1 monochrome bitmap selected.

HDC WinGCreateDC(void)

Return Value

Returns the handle to a new WinGDC if successful. Otherwise, **WinGCreateDC** returns 0.

Comments

Device contexts created using **WinGCreateDC** must be deleted using the [DeleteDC](#) function. All objects selected into the WinGDC after it was created should be selected out and replaced with the original objects before the device context is deleted.

When a WinGDC is created, WinG automatically selects the stock 1x1 monochrome bitmap as its drawing surface. To begin drawing on the WinGDC, select a WinGBitmap created by the [WinGCreateBitmap](#) function into the WinGDC.

Maximizing Performance

WinGCreateDC has a fairly high overhead and is usually used to create a single off-screen DC. In general, programs will call **WinGCreateDC** once at startup then select new WinGBitmaps on [WM_SIZE](#) messages to the double-buffered window. Applications can use the [WM_GETMINMAXINFO](#) message to restrict the size of their window if necessary.

Compose frames into WinGDCs, then use [WinGStretchBlt](#) or [WinGBitBlt](#) to copy the WinGDC to the screen.

Example

See the [WinGCreateBitmap](#) API for sample code that uses **WinGCreateDC**.

See Also

[WinGCreateBitmap](#) [CreateDC](#) [DeleteDC](#) [WM_SIZE](#) [WM_GETMINMAXINFO](#) [WinGStretchBlt](#) [WinGBitBlt](#) [CreateDIBSection](#) [Off-screen Drawing With WinG](#) [Maximizing Performance With WinG Code Samples](#)

WinGCreateHalftoneBrush

Creates a dithered pattern brush based on the WinG [halftone palette](#).

HBRUSH WinGCreateHalftoneBrush(HDC *hdc*, **COLORREF** *Color*, enum **WING_DITHER_TYPE** *DitherType*)

Parameters

- hdc* Specifies the DC with which the brush should be compatible.
- Color* Specifies the color to be approximated by the brush.
- DitherType* Specifies the dither pattern for the brush. Can be one of:
- WING_DISPERSED_4x4
 - WING_DISPERSED_8x8
 - WING_CLUSTERED_4x4

Return Value

Returns a handle to a GDI brush if successful. Otherwise, **WinGCreateHalftoneBrush** returns 0.

Comments

This API is intended for simulating true color on 8-bit devices. It will create a patterned brush using colors from the halftone palette regardless of the color resolution of the target device. If *hdc* refers to a 24-bit device, **WinGCreateHalftoneBrush** will not return a solid brush of the given color, it will return a colored dither pattern using colors that appear in the [halftone palette](#). On true-color devices, creating a solid brush that exactly matches the desired color is simple; **WinGCreateHalftoneBrush** lets you use the halftone patterns instead if you so desire.

A halftone brush approximates the requested *Color* using combinations of colors in the halftone palette. Larger dither patterns give a better approximation of the desired color but require more area to show the approximation. Quality is subjective, so programmers should experiment with different dither types to find the one that suits their needs.

If the target DC is a palette device and the WinG halftone palette has not been selected and realized into the target DC when a halftone brush is used, the visual results will be unpredictable. Use the [WinGCreateHalftonePalette](#) function to create a copy of the halftone palette, then select and realize it before using a halftone brush on a palette device.

The DISPERSED_nxn dither types create nxn patterns that approximate *Color* with a dispersed dot ordered dither.

The CLUSTERED_4x4 dither type creates a 4x4 pattern that approximates *Color* with a clustered dot ordered dither.

Always free GDI objects such as brushes by calling [DeleteObject](#) when the object is no longer needed.

Maximizing Performance

Avoid redundant creation, selection, and deletion of identical brushes as much as possible. If an application will be using the same brush repeatedly, it should create the brush once and save it for later use, deleting it when the application is complete.

Example

The CUBE sample application (in the SAMPLES\CUBE directory of the WinG Development Kit) allows the user to select the dither type for creating shaded brushes and provides a good experiment in using the different dither types.

See Also

[WinGCreateHalftonePalette](#) [WING_DITHER_TYPE](#) [CreateDIBPatternBrush](#) [CreateSolidBrush](#)
[Halftoning With WinG](#) [Using GDI With WinGDCs](#) [Code Samples](#)

WinGCreateHalftonePalette

Creates an 8-bit palette used for halftoning images.

HPALETTE WinGCreateHalftonePalette(void)

Return Value

Returns the handle of a [logical palette](#) containing the colors of the WinG [halftone palette](#) palette if successful. Otherwise, **WinGCreateHalftonePalette** returns 0.

Comments

The [halftone palette](#) should be selected into any DC into which the application will use WinG to halftone.

The WinG [halftone palette](#) is an [identity palette](#): the logical palette indices and physical device indices are the same.

The [halftone palette](#) inverts correctly, so bitwise XORs invert colors properly.

See the [Using an Identity Palette](#) article for a discussion of identity palettes.

Maximizing Performance

Call **WinGCreateHalftonePalette** once at the beginning of your application. Select and realize the palette on [WM_QUERYNEWPALETTE](#), [WM_PALETTECHANGED](#), and [WM_PAINT](#) messages.

Example

The [HALFTONE](#) sample application (in the SAMPLES\CUBE directory of the WinG Development Kit) uses the [halftone palette](#) to dither 24-bit images to 8-bits using an 8x8 ordered dither.

See Also

[WinGCreateHalftoneBrush](#) [WinGStretchBlt](#) [WinGBitBlt](#) [RealizePalette](#) [WM_QUERYNEWPALETTE](#) [WM_PALETTECHANGED](#) [Halftoning With WinG](#) [Using an Identity Palette](#) [Code Samples](#)

WinGGetDIBColorTable

Returns the color table of the WinGBitmap currently selected into a WinGDC.

UINT WinGGetDIBColorTable(HDC *hWinGDC*, UINT *StartIndex*, UINT *NumberOfEntries*, RGBQUAD far **pColors*)

Parameters

<i>hWinGDC</i>	Identifies the WinG device context whose color table should be retrieved.
<i>StartIndex</i>	Indicates the first palette entry to be retrieved.
<i>NumberOfEntries</i>	Indicates the number of palette entries to retrieve.
<i>pColors</i>	Points to a buffer which receives the requested color table entries.

Return Value

Returns the number of palette entries copied into the given buffer or 0 if it failed.

Comments

The *pColors* buffer must be at least large enough to hold *NumberOfEntries* RGBQUAD structures.

Note that *StartIndex* indicates an entry in a palette array, which is zero-based. *NumberOfEntries* indicates a count, which is one-based. If *NumberOfEntries* is zero, no color table entries will be retrieved.

WinGGetDIBColorTable will return 0 for WinGBitmaps with more than 8 bits per pixel.

See Also

[WinGSetDIBColorTable](#) [WinGCreateBitmap](#)

WinGGetDIBPointer

Retrieves information about a WinGBitmap and returns a pointer to its surface.

```
void far *WinGGetDIBPointer(HBITMAP hWinGBitmap, BITMAPINFO far *pHeader)
```

Parameters

hWinGBitmap Identifies the WinGBitmap whose surface should be retrieved.
p
pHeader If not 0, points to a buffer to receive the attributes and color table of the WinGDC.

Return Value

Returns a pointer to the bits of a WinGBitmap drawing surface if possible. Otherwise, **WinGGetDIBPointer** returns 0.

Comments

If it is supplied, *pHeader* must be large enough to hold a BITMAPINFOHEADER and enough RGBQUAD structures to hold the color table of the specified WinGBitmap.

If *hWinGBitmap* is not a WinGBitmap handle, this function will return 0 and **pHeader* will remain unchanged.

Maximizing Performance

WinGCreateBitmap uses or returns the information returned by **WinGGetDIBPointer** as part of the creation process. If possible, applications should store the data when the WinGBitmap is created rather than calling **WinGGetDIBPointer** every time the information is required.

The address of a WinGBitmap surface will remain the same for the life of the WinGBitmap.

See Also

WinGCreateDC WinGCreateBitmap BITMAPINFO BITMAPINFOHEADER

WinGRecommendDIBFormat

Fills in the entries of a [BITMAPINFO](#) structure with values that will give maximum performance for memory-to-screen blits using WinG.

BOOL WinGRecommendDIBFormat(BITMAPINFO far *pHeader)

Parameters

pHeader Points to a [BITMAPINFO](#) structure to receive the recommended DIB format.

Return Value

Returns non-zero if successful. Otherwise, returns zero.

Comments

pHeader must point to enough memory to hold a [BITMAPINFOHEADER](#).

WinGRecommendDIBFormat will not return a color table.

For any combination of hardware and software, there will be one DIB format that WinG can copy fastest from memory to the screen. **WinGRecommendDibFormat** returns this optimal format.

In many cases, WinG will find that it can copy a DIB to the screen faster if the DIB is in [top-down](#) format rather than the usual [bottom-up](#) format. **WinGRecommendDibFormat** will set the *biHeight* entry of the [BITMAPINFOHEADER](#) structure to -1 if this is the case, otherwise *biHeight* will be set to 1. See the [DIB Orientation](#) article for more information about these special DIBs.

Currently, **WinGRecommendDIBFormat** will always recommend an 8-bit-per-pixel format under Windows 3.1 and Win32s. Keep in mind that as WinG expands, other pixel formats will be supported. Code that uses this API should never assume that it will recommend an 8-bit format, as this may change depending on the run-time platform.

Example

See the [WinGCreateBitmap](#) API for sample code that uses **WinGRecommendDibFormat**.

See Also

[WinGCreateBitmap](#) [BITMAPINFO](#) [BITMAPINFOHEADER](#) [Code Samples](#)

WinGSetDIBColorTable

Modifies the color table of the currently selected WinGBitmap in a WinGDC.

```
UINT WinGSetDIBColorTable( HDC hWinGDC, UINT StartIndex, UINT NumberOfEntries,  
    RGBQUAD far *pColors )
```

Parameters

<i>hWinGDC</i>	Identifies the WinG device context whose color table should be modified.
<i>StartIndex</i>	Indicates the first palette entry to be changed.
<i>NumberOfEntries</i>	Indicates the number of palette entries to change.
<i>pColors</i>	Points to a buffer which contains the new color table values.

Return Value

Returns the number of palette entries modified in the specified device context or 0 if it failed.

Comments

The *pColors* buffer must hold at least *NumberOfEntries* RGBQUAD structures.

If you want to update the display immediately (for example, in [palette animation](#)), use [AnimatePalette](#) to modify the system palette and then call **WinGSetDIBColorTable** to match it or the WinGDC will be remapped when it is blt. See the [Palette Animation With WinG](#) article for more information and sample code that does this.

Note that *StartIndex* indicates an entry in a palette array, which is zero-based. *NumberOfEntries* indicates a count, which is one-based. If *NumberOfEntries* is zero, no color table entries will be modified.

Maximizing Performance

It is not necessary to call **WinGSetDIBColorTable** every time you call [AnimatePalette](#). Only call this API if you are about to blt and the destination palette has changed since the last call to **WinGSetDIBColorTable**.

Example

See the section titled [Palette Animation With WinG](#) for sample code and discussion of using **WinGSetDIBColorTable** to perform palette animation.

The [PALANIM](#) sample, in the SAMPLES\PALANIM subdirectory of the WinG Development Kit, performs simple palette animation and maintains an [identity palette](#) throughout.

See Also

[WinGGetDIBColorTable](#) [WinGCreateBitmap](#) [Palette Animation With WinG](#)

WinGStretchBlt

Copies the source DC to the destination DC, resizing if necessary to fill the destination rectangle. Optimized for blting WinGDCs to screen DCs.

BOOL WinGStretchBlt(HDC *hdcDest*, int *nXOriginDest*, int *nYOriginDest*, int *nWidthDest*, int *nHeightDest*, HDC *hdcSrc*, int *nXOriginSrc*, int *nYOriginSrc*, int *nWidthSrc*, int *nHeightSrc*)

Parameters

<i>hdcDest</i>	Identifies the destination device context.
<i>nXOriginDest</i>	X coordinate of the upper-left corner of the destination rectangle in MM_TEXT client coordinates.
<i>nYOriginDest</i>	Y coordinate of the upper-left corner of the destination rectangle in MM_TEXT client coordinates.
<i>nWidthDest</i>	Width of the destination rectangle..
<i>nHeightDest</i>	Height of the destination rectangle..
<i>hdcSrc</i>	Identifies the source device context.
<i>nXOriginSrc</i>	X coordinate of the upper-left corner of the source rectangle in MM_TEXT client coordinates.
<i>nYOriginSrc</i>	Y coordinate of the upper-left corner of the source rectangle in MM_TEXT client coordinates.
<i>nWidthSrc</i>	Width of the source rectangle.
<i>nHeightSrc</i>	Height of the source rectangle.

Return Value

Returns non-zero if successful, otherwise returns zero.

Comments

WinGStretchBlt requires both DCs to use MM_TEXT mapping mode at the time of the call or the results may be unpredictable. At other times, any mapping mode may be used in either DC.

WinGStretchBlt uses the STRETCH_DELETESCANS mode when expanding or shrinking an image, so stretched images may appear chunky.

In the current implementation, **WinGStretchBlt** will fail under Windows 3.1 or Win32s if the source DC is not an 8-bit-per-pixel WinGDC. Future implementations will allow for different pixel formats for WinGBitmaps.

Maximizing Performance

You will get the highest performance from **WinGStretchBlt** if you use a WinGBitmap created from header information supplied by a call to WinGRecommendDIBFormat.

WinGStretchBlt is optimized for copying WinGDCs to the screen.

Stretching by integer ratios is faster than arbitrary ratios. 1 to 2 and 1 to 4 stretching are fastest.

Clipping can slow **WinGStretchBlt** down. In general, dont select clipping regions into or blt outside the boundaries of the source or destination DCs and avoid blting to an overlapped window if possible.

See Also

[WinGBitBlt](#) [WinGCreateDC](#) [WinGCreateBitmap](#) [WinGRecommendDIBFormat](#) [Maximizing Performance With WinG](#)

WING_DITHER_TYPE

Dither types for halftone brushes.

WING_DITHER_TYPE

Values

DISPERSED_4x4
DISPERSED_8x8
CLUSTERED_4x4

See Also

[WinGCreateHalftoneBrush](#) [WinGCreateHalftonePalette](#) [Halftoning With WinG](#) [CUBE](#)

```

HPALETTE CreateIdentityPalette(RGBQUAD aRGB[], int nColors)
{
    int i;
    struct {
        WORD Version;
        WORD NumberOfEntries;
        PALETTEENTRY aEntries[256];
    } Palette =
    {
        0x300,
        256
    };

    /*** Just use the screen DC where we need it
    HDC hdc = GetDC(NULL);

    /*** For SYSPAL_NOSTATIC, just copy the color table into
    /*** a PALETTEENTRY array and replace the first and last entries
    /*** with black and white
    if (GetSystemPaletteUse(hdc) == SYSPAL_NOSTATIC)
    {
        /*** Fill in the palette with the given values, marking each
        /*** as PC_NOCOLLAPSE
        for(i = 0; i < nColors; i++)
        {
            Palette.aEntries[i].peRed = aRGB[i].rgbRed;
            Palette.aEntries[i].peGreen = aRGB[i].rgbGreen;
            Palette.aEntries[i].peBlue = aRGB[i].rgbBlue;
            Palette.aEntries[i].peFlags = PC_NOCOLLAPSE;
        }

        /*** Mark any unused entries PC_NOCOLLAPSE
        for (; i < 256; ++i)
        {
            Palette.aEntries[i].peFlags = PC_NOCOLLAPSE;
        }

        /*** Make sure the last entry is white
        /*** This may replace an entry in the array!
        Palette.aEntries[255].peRed = 255;
        Palette.aEntries[255].peGreen = 255;
        Palette.aEntries[255].peBlue = 255;
        Palette.aEntries[255].peFlags = 0;

        /*** And the first is black
        /*** This may replace an entry in the array!
        Palette.aEntries[0].peRed = 0;
        Palette.aEntries[0].peGreen = 0;
        Palette.aEntries[0].peBlue = 0;
        Palette.aEntries[0].peFlags = 0;
    }
    else
        /*** For SYSPAL_STATIC, get the twenty static colors into
        /*** the array, then fill in the empty spaces with the
        /*** given color table

```

```

{
    int nStaticColors;
    int nUsableColors;

    /*** Get the static colors from the system palette
    nStaticColors = GetDeviceCaps(hdc, NUMCOLORS);
    GetSystemPaletteEntries(hdc, 0, 256, Palette.aEntries);

    /*** Set the peFlags of the lower static colors to zero
    nStaticColors = nStaticColors / 2;
    for (i=0; i<nStaticColors; i++)
        Palette.aEntries[i].peFlags = 0;

    /*** Fill in the entries from the given color table
    nUsableColors = nColors - nStaticColors;
    for (; i<nUsableColors; i++)
    {
        Palette.aEntries[i].peRed = aRGB[i].rgbRed;
        Palette.aEntries[i].peGreen = aRGB[i].rgbGreen;
        Palette.aEntries[i].peBlue = aRGB[i].rgbBlue;
        Palette.aEntries[i].peFlags = PC_NOCOLLAPSE;
    }

    /*** Mark any empty entries as PC_NOCOLLAPSE
    for (; i<256 - nStaticColors; i++)
        Palette.aEntries[i].peFlags = PC_NOCOLLAPSE;

    /*** Set the peFlags of the upper static colors to zero
    for (i = 256 - nStaticColors; i<256; i++)
        Palette.aEntries[i].peFlags = 0;
}

/*** Remember to release the DC!
ReleaseDC(NULL, hdc);

/*** Return the palette
return CreatePalette((LOGPALETTE *)&Palette);
}

```

```

void ClearSystemPalette(void)
{
    /*** A dummy palette setup
    struct
    {
        WORD Version;
        WORD NumberOfEntries;
        PALETTEENTRY aEntries[256];
    } Palette =
    {
        0x300,
        256
    };

    HPALETTE ScreenPalette = 0;
    HDC ScreenDC;
    int Counter;

    /*** Reset everything in the system palette to black
    for(Counter = 0; Counter < 256; Counter++)
    {
        Palette.aEntries[Counter].peRed = 0;
        Palette.aEntries[Counter].peGreen = 0;
        Palette.aEntries[Counter].peBlue = 0;

        Palette.aEntries[Counter].peFlags = PC_NOCOLLAPSE;
    }

    /*** Create, select, realize, deselect, and delete the palette
    ScreenDC = GetDC(NULL);
    ScreenPalette = CreatePalette((LOGPALETTE *)&Palette);
    if (ScreenPalette)
    {
        ScreenPalette = SelectPalette(ScreenDC,ScreenPalette,FALSE);
        RealizePalette(ScreenDC);
        ScreenPalette = SelectPalette(ScreenDC,ScreenPalette,FALSE);
        DeleteObject(ScreenPalette);
    }
    ReleaseDC(NULL, ScreenDC);
}

```



```

HBITMAP ghBitmapMonochrome = 0;

HDC Create100x100WinGDC(void)
{
    HDC hWinGDC;
    HBITMAP hBitmapNew;
    struct {
        BITMAPINFOHEADER InfoHeader;
        RGBQUAD ColorTable[256];
    } Info;
    void far *pSurfaceBits;

    // Set up an optimal bitmap
    if (WinGRecommendDIBFormat((BITMAPINFO far *)&Info) == FALSE)
        return 0;

    // Set the width and height of the DIB but preserve the
    // sign of biHeight in case top-down DIBs are faster
    Info.InfoHeader.biHeight *= 100;
    Info.InfoHeader.biWidth = 100;

    /*** DONT FORGET A COLOR TABLE! ***/
    /*** COLOR TABLE CODE HERE ***/

    // Create a WinGDC and Bitmap, then select away
    hWinGDC = WinGCreateDC();
    if (hWinGDC)
    {
        hBitmapNew = WinGCreateBitmap(hWinGDC,
            (BITMAPINFO far *)&Info, &pSurfaceBits);
        if (hBitmapNew)
        {
            ghBitmapMonochrome = (HBITMAP)SelectObject(hWinGDC,
                hBitmapNew);
        }
        else
        {
            DeleteDC(hWinGDC);
            hWinGDC = 0;
        }
    }
    return hWinGDC;
}

void Destroy100x100WinGDC(HDC hWinGDC)
{
    HBITMAP hBitmapOld;

    if (hWinGDC && ghBitmapMonochrome)
    {
        // Select the stock 1x1 monochrome bitmap back in
        hBitmapOld = (HBITMAP)SelectObject(hWinGDC,
            ghBitmapMonochrome);
        DeleteObject(hBitmapOld);
    }
}

```

```
    DeleteDC(hWinGDC);  
  }  
}
```



```
#define NumSysColors (sizeof(SysPalIndex)/sizeof(SysPalIndex[1]))
#define rgbBlack RGB(0,0,0)
#define rgbWhite RGB(255,255,255)
```

```
/** These are the GetSysColor display element identifiers
```

```
static int SysPalIndex[] = {
    COLOR_ACTIVEBORDER,
    COLOR_ACTIVECAPTION,
    COLOR_APPWORKSPACE,
    COLOR_BACKGROUND,
    COLOR_BTNFACE,
    COLOR_BTNSHADOW,
    COLOR_BTNTEXT,
    COLOR_CAPTIONTEXT,
    COLOR_GRAYTEXT,
    COLOR_HIGHLIGHT,
    COLOR_HIGHLIGHTTEXT,
    COLOR_INACTIVEBORDER,
    COLOR_INACTIVECAPTION,
    COLOR_MENU,
    COLOR_MENUTEXT,
    COLOR_SCROLLBAR,
    COLOR_WINDOW,
    COLOR_WINDOWFRAME,
    COLOR_WINDOWTEXT
};
```

```
/** This array translates the display elements to black and white
```

```
static COLORREF MonoColors[] = {
    rgbBlack,
    rgbWhite,
    rgbWhite,
    rgbWhite,
    rgbWhite,
    rgbBlack,
    rgbBlack,
    rgbBlack,
    rgbBlack,
    rgbBlack,
    rgbWhite,
    rgbWhite,
    rgbWhite,
    rgbWhite,
    rgbBlack,
    rgbWhite,
    rgbWhite,
    rgbBlack,
    rgbBlack
};
```

```
/** This array holds the old color mapping so we can restore them
static COLORREF OldColors[NumSysColors];
```

```
/** AppActivate sets the system palette use and
/** remaps the system colors accordingly.
```

```

void AppActivate(BOOL fActive)
{
    HDC hdc;
    int i;

    /*** Just use the screen DC
    hdc = GetDC(NULL);

    /*** If the app is activating, save the current color mapping
    /*** and switch to SYSPAL_NOSTATIC
    if (fActive && GetSystemPaletteUse(hdc) == SYSPAL_STATIC)
    {
        /*** Store the current mapping
        for (i=0; i<NumSysColors; i++)
            OldColors[i] = GetSysColor(SysPalIndex[i]);

        /*** Switch to SYSPAL_NOSTATIC and remap the colors
        SetSystemPaletteUse(hdc, SYSPAL_NOSTATIC);
        SetSysColors(NumSysColors, SysPalIndex, MonoColors);
    }
    else if (!fActive && GetSystemPaletteUse(hdc) == SYSPAL_NOSTATIC)
    {
        /*** Switch back to SYSPAL_STATIC and the old mapping
        SetSystemPaletteUse(hdc, SYSPAL_STATIC);
        SetSysColors(NumSysColors, SysPalIndex, OldColors);
    }

    /*** Be sure to release the DC!
    ReleaseDC(NULL,hdc);
}

```

WinG Glossary

Bottom-Up DIB: A DIB in which the first scan line in memory corresponds to the bottommost scanline when the DIB is displayed. This is the standard Windows DIB format.

Color Table: The table of RGB color values referenced by an color-indexed DIB.

Dirty Rectangle Animation: A double-buffering technique in which only the areas on the screen which have changed are updated from frame to frame.

Double Buffering: An animation technique in which images are composed entirely off-screen then copied in whole or in part to the display.

Halftone Palette: An identity palette carefully filled with an array of colors optimized for dithering images to 8 bits per pixel.

Halftoning: A technique for simulating unavailable colors using special patterns of available colors. Also called dithering.

Identity Palette: A logical palette that is a 1:1 match to the system palette.

Logical Palette: A palette object created by an application using the [CreatePalette](#) function.

Palette: A table of RGB colors associated with a GDI Device Context.

Palette Animation: An animation technique in which palette entries are shifted to create the appearance of movement.

Static Colors: Reserved colors in the system palette that can never be changed by an application. Under normal circumstances, twenty colors are so reserved.

System Colors: The colors used by Windows to draw captions, menu bars, text, and other Windows display elements.

System Palette: A copy of the hardware device palette maintained by the Palette Manager.

Top-Down DIB: A DIB in which the first scan line in memory corresponds to the topmost scanline when the DIB is displayed.

WinGBitmap: A special [HBITMAP](#) with a DIB as its drawing surface created for use in a WinGDC.

WinGDC: A device context with a DIB as its drawing surface.

Twenty colors in the system palette that can never be changed by an application.

The colors used by Windows to draw captions, menu bars, text, and other Windows display elements.

A copy of the hardware palette maintained by the Palette Manager.

A palette object created by an application using the **CreatePalette** function.

The table of RGB color values referenced by an color-indexed DIB.

A logical palette that is a 1:1 match to the system palette.

An identity palette carefully filled with an array of colors optimized for dithering images to 8 bits per pixel.

An animation technique in which palette entries are shifted to create the appearance of movement.

A standard Windows DIB in which the bottommost scanline is stored first in memory.

A special DIB in which the topmost scanline is stored first in memory.

Nirvana has ever been a difficult concept to explain. It is a state of mind achieved through diligence and meditation, a state of complete tranquility and awareness in which conscious thought ceases to exist as such, the final step in the struggle for the cessation of suffering.

Further Reading

The following collection of books, articles, and sample code may help clarify the use of DIBs, provide insight into custom drawing routines, or generally ease the transition from device-dependent bitmaps to WinGDCs. All of these are available on the Microsoft Developer Network CD or through the Microsoft Developer Relations Group. Some are included with the Windows SDK.

Foley, vanDam, Feiner, and Hughes, Computer Graphics: Principles and Practice, Second Edition, Addison-Wesley, 1991

Gery, Ron, Using DIBs with Palettes, Microsoft Technical Article, 3 March 1992

Gery, Ron, DIBs and Their Use, Microsoft Technical Article, 20 March 1992

Gery, Ron, The Palette Manager: How and Why, Microsoft Technical Article, 23 March 1992

Petzold, Charles, The Device-Independent Bitmap (DIB), Programming Windows 3.1, Microsoft Press, 1992, pp. 607-619

Rodent, Herman, Animation In Windows, Microsoft Technical Article, 28 April 1993

How To Use a DIB Stored as a Windows Resource, Microsoft PSS Article Q67883, 26 April 1993

Multimedia Video Techniques, Microsoft Technical Article, 20 March 1992

Windows 3.1 Software Development Kit samples: DIBIT, DIBVIEW, CROPDIB, WINCAP, SHOWDIB, FADE

Microsoft Technical Samples, TRIQ, draws triangles or boxes directly into device-independent bitmap memory.

