

HowToCode7

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Chapter 1

HowToCode7

1.1 HowToCode: AGA Chipset

The AGA Chipset (Amiga 1200/4000)

**** WARNING ****

AGA Registers are temporary. They will change. Do not rely on this documentation. No programs written with this information can be officially endorsed or supported by Commodore. If this bothers you then stop reading now.

Future Amigas will **NOT** support **ANY** of the new AGA registers. If you want your product to work on the next generation of Amigas then either:

- a) Program for ECS only (**MOST** ECS will be supported. Don't rely on Productivity or SuperHires mode via hardware though!)
- b) Program your displays via the OS, either using graphics.library (views) or intuition.library (screens). If you use the OS then any UserCopperList code you add must **ONLY** be for ECS level instructions or lower (so, sorry, no 24-bit rainbows).

I have decided to include this material as there are still reasons for people to program AGA hardware, especially demo coders. PLEASE do not let me down by using this information to write commercial software. If this happens I will have to remove the AGA docs from HowToCode.

And as soon as Commodore provide a suitable way for all programmers to access the power of the A1200/4000 chipset in a supportable way, this file will be removed and replaced with one that tells you how to code properly. But in the meantime.....

- 1 How do I tell what chipset I am using?
- 2 Programming the AGA hardware
- 3 Monitor type problems
- 4 Resetting sprites on AGA machines

1.2 How do I tell what chipset I am using?

How do I tell what chipset I am using?

Do **NOT** check library revision numbers, V39 OS can and does run on standard & ECS chipset machines (My Amiga 3000 is currently running V39).

This code is a much better check for AGA than in howtocode4!!!!

```
GFXB_AA_ALICE    equ 2
gb_ChipRevBits0  equ $ec
```

; Call with a6 containing GfxBase from opened graphics.library

```
    btst    #GFXB_AA_ALICE,gb_ChipRevBits0(a6)
    bne.s   is_aa
```

This will not work unless the V39 SetPatch command has been executed. If you **must** use trackloader demos then execute the graphics.library function

```
    SetChipRev(chipset)
```

This is a V39 function (No Kickstart 3.0? Then you haven't got AGA!).

You can set the chipset you require with the following parameters:

```
Normal = $00
ECS     = $03          (Only on ECS or higher)
AGA     = $0f          (Only on AGA chipset machines)
Best    = $ffffffff    (This gives best possible on machine)
```

This is called in the system by SetPatch.

The code in howtocode4 also had major problems when being run on non ECS machines (without Super Denise or Lisa), as the register was undefined under the original (A) chipset, and would return garbage, sometimes triggering a false AGA-present response.

1.3 Programming the AGA hardware

Programming AGA hardware

- 1 Bitplanes
- 2 Colours
- 3 Sprites
- 4 Alignment Restrictions
- 5 The Magic FMode Register
- 6 Fetch Modes Required for Displays [table]
- 7 Smoother hardware scrolling
- 8 Ham-8 Mode

1.4 Bitplanes:

Bitplanes:

Set bits 0 to 7 bitplanes as before in BPLCON0 (for 0 to 7 bitplanes)

For 8 bitplanes you should set bit 4 (BPU3) of BPLCON0
bits 12 to 14 (BPU0 to BPU2) should be zero.

Using 64-colour mode (NOT extra halfbrite) requires setting the
KILLEHB (bit 9) in BPLCON2.

Super Hires can be enabled by bit 6 (SHRES) of BPLCON0

1.5 Colour Registers:

Colour Registers

There are now 256 24-bit colour registers, all accessed through the original
32 12-bit colour registers. If you suspect this sounds like it could
be messy, then you're right, it is!

AGA works with 8 different palettes of 32 colors each, re-using
colour registers from COLOR00 to COLOR31

You can choose the palette you want to access via bits 13 to 15 of
register BPLCON3.

BANK2	BANK1	BANK0	
bit 15	bit 14	bit 13	Selected palette
0	0	0	Palette 0 (color 0 to 31)
0	0	1	Palette 1 (color 32 to 63)
0	1	0	Palette 2 (color 64 to 95)
0	1	1	Palette 3 (color 96 to 127)
1	0	0	Palette 4 (color 128 to 159)
1	0	1	Palette 5 (color 160 to 191)
1	1	0	Palette 6 (color 192 to 223)
1	1	1	Palette 7 (color 224 to 255)

To move a 24-bit colour value into a colour register requires two writes to the register:

First clear bit 9 (LOCT) of BPLCON3

Move high nibbles of each colour component to colour registers

Then set bit 9 (LOCT) of BPLCON3

Move low nibbles of each colour components to colour registers

For example, to change colour zero to the colour \$123456

```
lea      (CUSTOM.L),a0
move.w   #$0135,COLOR00(a0)
move.w   #$0200,BPLCON3(a0)
move.w   #$0245,COLOR00(a0)
move.w   #$0000,BPLCON3(a0)
```

1.6 AGA Sprites

Sprites

To change the resolution of the sprite, just use bit 7 and 6 of register BPLCON3

bit 7	bit 6	Resolution
0	0	ECS Defaults (Lo-res/Hi-res = 140ns, Superhires = 70ns)
0	1	Always lowres (140ns)
0	1	Always hireres (70ns)
1	1	Always superhires (35ns)

For 32-bit and 64-bit wide sprites use bit 3 and 2 of register FMODE (\$dfff1fc) Sprite format (in particular the control words) vary for each width.

bit 3	bit 2	Wide	Control Words
0	0	16 pixels	2 words (normal)
1	0	32 pixels	2 longwords
0	1	32 pixels	2 longwords
1	1	64 pixels	2 double long words (4 longwords)

Wider sprites are not available under all conditions.

It is possible to choose the color palette of the sprite. This is done with bits 0 to 3 (even) and 4 to 7 (odd) of register \$010C.

bit 3	bit 2	bit 1	bit 0	Even sprites
bit 7	bit 6	bit 5	bit 4	Odd Sprites
0	0	0	0	\$0180/palette 0 (coulor 0)

0		0		0		1		\$01A0/palette 0 (color 15)
0		0		1		0		\$0180/palette 1 (color 31)
0		0		1		1		\$01A0/palette 1 (color 47)
0		1		0		0		\$0180/palette 2 (color 63)
0		1		0		1		\$01A0/palette 2 (color 79)
0		1		1		0		\$0180/palette 3 (color 95)
0		1		1		1		\$01A0/palette 3 (color 111)
1		0		0		0		\$0180/palette 4 (color 127)
1		0		0		1		\$01A0/palette 4 (color 143)
1		0		1		0		\$0180/palette 5 (color 159)
1		0		1		1		\$01A0/palette 5 (color 175)
1		1		0		0		\$0180/palette 6 (color 191)
1		1		0		1		\$01A0/palette 6 (color 207)
1		1		1		0		\$0180/palette 7 (color 223)
1		1		1		1		\$01A0/palette 7 (color 239)

See `Resetting sprites` for an OS legal method of setting sprite resolution.

1.7 Alignment Restrictions

Alignment Restrictions

Bitplanes, sprites and copperlists must be, under certain circumstances, 64-bit aligned under AGA. Again to benefit from maximum bandwidth bitplanes should also only be multiples of 64-bits wide, so if you want an extra area on the side of your screen for smooth blitter scrolling it must be *8 bytes* wide, not two as normal.

This also raises another problem. You can no longer use `AllocMem()` to allocate bitplane/sprite memory directly.

Either use `AllocMem(sizeofplanes+8)` and calculate how many bytes you have to skip at the front to give 64-bit alignment (remember this assumes either you allocate each bitplane individually or make sure the bitplane size is also an exact multiple of 64-bits), or you can use the new V39 function `AllocBitMap()`.

The Magic FMode Requester

1.8 The Magic FMode Register

The Magic FMode Register

If you set your 1200/4000 to a hiresmode (such as 1280x512 Superhires 256 colours) and disassemble the copperlist, you find fun things happen to the FMODE register (`$dfflfc`). The FMODE register determines the amount of words transferred between chipram and the Lisa chip in each data fetch (I think)....

\$dfflfc bits 0 and 1 value

\$00 - Normal (word aligned bitmaps) - for standard ECS modes
and up to 8 bitplanes 320x256

\$01 - Double (longword aligned bitmaps) - for 640x256 modes in
more than 16 colours

\$10 - Double (longword aligned bitmaps) - Same effect, for 640x256 modes
but different things happen... Not sure why!

\$11 - Quadruple [x4] (64-bit aligned bitmaps) - for 1280x256 modes...

Fetch Modes Required for Displays [table]

1.9 Fetch Modes Required for Displays [table]

Fetch Mode Required for Displays

ALL ECS and lower screenmodes require only 1x datafetch. All modes
run *FASTER* with at least 2x bandwidth, so try and use 2x bandwidth
if possible.

	Planes	Colours	Fetchmode
LORES (320x256)	6	64	1
	7	128	1
	8	256	1
	8	HAM-8	1
HIRES (640x256)	5	32	2
	6	64	2
	7	128	2
	8	256	2
	8	HAM-8	2
SUPER-HIRES (1280x256)	1	2	1
	2	4	1
	3	8	2
	4	16	2
	5	32	4
	6	64	4
	7	128	4
	8	256	4
	8	HAM-8	4
PRODUCTIVITY (640x480, etc)	1	2	1
	2	4	1
	3	8	2
	4	16	2
	5	32	4
	6	64	4

7	128	4
8	256	4
8	HAM-8	4

This table only shows the minimum required fetchmode for each screen. You should always try and set the fetchmode as high as possible (if you are 64-bit aligned and wide, then \$11, if 32-bit aligned and wide \$01, etc...)

Bits 2 and 3 do the same for sprite width, as has been mentioned elsewhere...

Remember... To take advantage of the increased fetchmodes (which give you more processor time to play with!) your bitmaps must be on 64-bit boundaries and be multiples of 64-bits wide (8 bytes)

1.10 Smoother Hardware Scrolling

Smoother Hardware Scrolling

Extra bits have been added to BPLCON1 to allow smoother hardware scrolling and scrolling over a larger area.

Bits 8 (PF1H0) and 9 (PF1H1) are the new hi-resolution scroll bits for playfield 0 and bits 12 (PF2H0) and 13 (PF2H1) are the new bits for playfield 1.

Another two bits have been added for each bitplane at bits 10 (PF1H6) and 11 (PF1H7) for playfield 1 and bits 14 (PF2H6) and 15 (PF2H7) to increase the maximum scroll range from 16 lo-res pixels to 64 lo-res pixels (or 256 superhires pixels).

Normal 0-16 positions therefore are normal, but if you want to position your screen at a (super) hires position you need to set the new bits, or if you require smooth hardware scrolling with either 2x or 4x Fetch Mode .

1.11 What is Ham-8 format?

What is HAM-8 Format?

Ham8 mode is enabled when the HAM bit is set in BPLCON0 and 8 bitplanes are specified.

Ham-8 uses *lower* two bits as the command (either new register (%00), or alter Red, Green or Blue component, as in standard HAM), and the *upper* 6 bits (planes 2 to 7) as the register(0 to 63), or as an 6 bit hold-and-modify value to modify the top 6 bits of an 8-bit colour component.

The lower two bits of the colour component are not altered, so

initial palettes have to be chosen carefully (or use Art Department Professional or anything that selects colours better)

1.12 Monitor type problems

Monitor Problems

Unfortunately the A1200/AGA chipset does not have the deinterlacer circuitry present in the Amiga 3000, but instead has new 'deinterlaced' modes. This gives the A1200 the capability of running workbench (and almost all OS legal software) the ability to run flicker free at high resolution on a multiscan or Super VGA monitor.

Unlike the Amiga 3000 hardware it produces these flicker free modes by generating a custom copperlist, so any programs that generate their own copperlists will continue to run at the old flickery 15Khz frequency unless they add their own deinterlace code.

This is a big problem for many A1200 owners as there are very few multiscan monitors that support 15Khz displays now. Most multiscan monitors will not display screen at less than 27Khz. People with A1200/4000 and this kind of monitor *CANNOT* view any games or demos that write their own copperlists.

Can you help them out? Unfortunately it's not easy. Deinterlacing is done in AGA by doing two things.

Firstly different horizontal and vertical frequencies are set (These are set to unusual values for anyone used to Amiga or PC displays! For example, DblPal is set by default to 27Khz horizontal and 48Hz vertical) It's important to realise that the vertical frequency changes too!

Seondly, for non-interlaced screens, bitplane scandoubling is enabled (bit BSCAN2 in FMODE) This repeats each scanline twice. A side effect of this is that the bitplane modulus are unavailable for user control.

So... There are three options.

1. Write nasty copperlist code to work with both standard and promoted displays (Not a good idea!)
2. Use the OS and set up your displays legally, asking the Display Database for a screenmode that is available for the current monitor.
3. Give up, and say your demo requires a 15Khz monitor.

I think most people will go for option 3. The Commodore 1084/1085, Phillips 8833/8852 and the Commodore 1950/1960/1940/1942 monitors are all capable of running 15Khz screens.

1.13 exec.library/AllocMem()

AllocMem -- allocate memory given certain requirements

```
memoryBlock = AllocMem(byteSize, attributes)
               D0          -198          D0          D1
```

```
void *AllocMem(ULONG, ULONG);
```

1.14 graphics.library/AllocBitMap()

AllocBitMap -- Allocate a bitmap and attach bitplanes to it. (V39)

```
bitmap=AllocBitMap(sizeX,sizeY,depth, flags, friend_bitmap)
               -918          d0          d1          d2          d3          a0
```

```
struct BitMap *AllocBitMap(ULONG,ULONG,ULONG,ULONG, struct BitMap *);
```

Allocates and initializes a bitmap structure. Allocates and initializes bitplane data, and sets the bitmap's planes to point to it.

IN:

sizeX = the width (in pixels) for the bitmap data.

sizeY = the height (in pixels).

depth = the number of bitplanes deep for the allocation.

flags = BMF_CLEAR - Clear the bitmap.

BMF_DISPLAYABLE - bitmap displayable on AGA machines in all modes.

BMF_INTERLEAVED - bitplanes are interleaved

friend_bitmap = pointer to another bitmap, or NULL. If this pointer
If present, bitmap will be allocated so blitting
between the two is simplified.

SEE ALSO

FreeBitMap()

1.15 graphics.library/FreeBitMap()

FreeBitMap -- free a bitmap created by AllocBitMap

```
FreeBitMap(bm)
           -924          a0
```

```
VOID FreeBitMap(struct BitMap *)
```

Frees bitmap and all associated bitplanes

IN:

bm = A pointer to a BitMap.

1.16 Resetting AGA sprite resolution

This is a totally OS-legal way of resetting sprite resolution to 140ns (ECS default). call FixSpritesSetup: *BEFORE* your LoadView(NULL) in your startup code, and ReturnSpritesToNormal: *BEFORE* the LoadView(wbview) that returns workbench in your exit code:

Here is the assembler version of the code: See startup.asm for an integrated example of this code:

; Setup code - assumes V39 Kickstart or higher

```
FixSpritesSetup:
    move.l    _IntuitionBase,a6          ; open intuition.library first!
    lea       wbname,a0
    jsr       _LVOLockPubScreen(a6)

    tst.l     d0                        ; Could I lock Workbench?
    beq.s     .error                    ; if not, error
    move.l     d0,wbscreen
    move.l     d0,a0

    move.l     sc_ViewPort+vp_ColorMap(a0),a0
    lea       taglist,a1
    move.l     _GfxBase,a6              ; open graphics.library first!
    jsr       _LVOVideoControl(a6)      ;

    move.l     resolution,oldres         ; store old resolution

    move.l     #SPRITERESN_140NS,resolution
    move.l     #VTAG_SPRITERESN_SET,taglist

    move.l     wbscreen,a0
    move.l     sc_ViewPort+vp_ColorMap(a0),a0
    lea       taglist,a1
    jsr       _LVOVideoControl(a6)      ; set sprites to lores

    move.l     wbscreen,a0
    move.l     _IntuitionBase,a6
    jsr       _LVOMakeScreen(a6)
    jsr       _LVORethinkDisplay(a6)    ; and rebuild system copperlists

; Sprites are now set back to 140ns in a system friendly manner!

.error
    rts
```

ReturnSpritesToNormal:

; If you mess with sprite resolution you must return resolution
; back to workbench standard on return! This code will do that...

```

        move.l    wbscreen,d0
        beq.s     .error
        move.l    d0,a0

        move.l    oldres,resolution          ; change taglist
        lea       taglist,a1
        move.l    sc_ViewPort+vp_ColorMap(a0),a0
        move.l    _GfxBase,a6
        jsr       _LVOVideoControl(a6)       ; return sprites to normal.

        move.l    _IntuitionBase,a6
        move.l    wbscreen,a0
        jsr       _LVOMakeScreen(a6)         ; and rebuild screen

        move.l    wbscreen,a1
        sub.l     a0,a0
        jsr       _LVOUnlockPubScreen(a6)

.error
        rts

oldres      dc.l   0
wbscreen    dc.l   0

taglist     dc.l   VTAG_SPRITERESN_GET
resolution  dc.l   SPRITERESN_ECS
            dc.l   TAG_DONE,0

wbname      dc.b   "Workbench",0

```

1.17 intuition.library/LockPubScreen()

LockPubScreen -- Put a lock on a Public Screen.

```

screen = LockPubScreen( Name )
D0      -510      A0

struct Screen *LockPubScreen( UBYTE * );

```

Prevents a public screen (or the Workbench) from closing.

1.18 intuition.library/UnlockPubScreen()

UnlockPubScreen -- Remove lock from a Public Screen.

```

UnlockPubScreen( Name, [Screen] )
-516      A0      A1

VOID UnlockPubScreen( UBYTE *, struct Screen * );

```

Releases a lock from LockPubScreen()

IN:

Usually Name = NULL and Screen = pointer returned by LockPubScreen()

1.19 graphics.library/VideoControl()

VideoControl -- Parse tags on viewport colormap.

```
err = VideoControl( cmap , tags )
d0          -708      a0      a1
```

ULONG VideoControl(struct ColorMap *, struct TagItem *);

Process the tag commands on the colormap.

IN:

cm = pointer to struct ColorMap
tags = pointer to a table of videocontrol tagitems.

OUT:

error = NULL if no error occurred.

1.20 graphics.library/SetChipRev()

SetChipRev -- Enables Chip Set features

```
chipbits = SetChipRev(Rev)
-888      d0
```

IN:

Rev - Revision to be enabled (\$ffffffff for best possible)

OUT:

chipbits - State of chipset on exit.

Only call this routine once. It is called by the OS in SetPatch, but you should use it if you are writing Non-DOS demos or games.
