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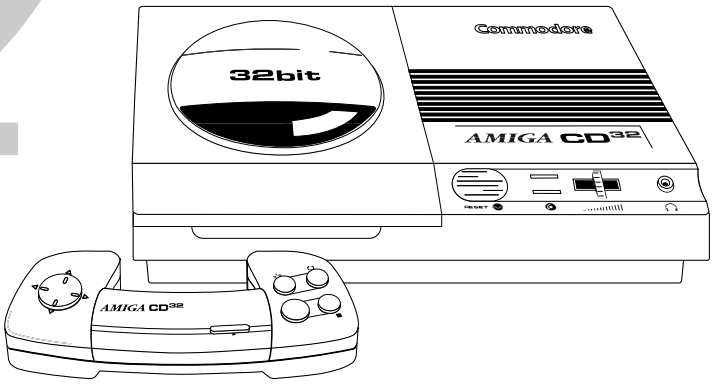
Revision

This is revision 2 of this document, May 19,1993

Contents

1 Introduction



An exciting product has emerged from Commodore engineering. It combines the graphics excellence of the Amiga computer family with the megastorage and audio purity of the CD-ROM, making it an instant force for all to reckon with. There's a new standard in the video game world and its name is the Amiga CD^{32} game system.

The Amiga CD^{32} is an entry level, 32-bit CD game console based on the Amiga AA chip set and a 68EC020 microprocessor. The AA chips, the latest of the custom chip sets that characterize the Amiga family, provides a palette of 16 million colors, a dazzling variety of display modes and four-voice, 8-bit, stereo audio.

This is a machine that can transport players into the vortex of an alien hyperspace or the depths of a dank dungeon far below an evil warlock's castle. You'll be able to provide your starship captains with full-motion video on their viewscreens and klaxons so real, the neighbors will go to general quarters. The Amiga CD^{32} is a product ready to do battle in the fiercely competitive game market, but it can't go it alone, it needs a software creator. It needs you.

In this document, we present sections on the Amiga CD^{32} hardware and system software, title production, game programming techniques, expansion hardware, and reference documentation.

Section Outlines

1	**Introduction**	What Amiga CD^{32} is, why it exists, who will buy it and who is the competition.
2	**Producing Titles**	Development tools, porting existing Amiga titles, CD mastering and duplication, and distribution information.
3	**Writing OS-Friendly Games**	The CD^{32} libraries, file system and game programming techniques.
4	**Includes and Autodocs**	Reference material for the Amiga CD^{32} libraries and file system.
A	**Questions and Answers**	Answers to commonly asked questions.

Amiga CD^{32} Hardware Summary

The Amiga CD^{32} is a game system first, then a computer. Its basic hardware configuration reflects this. The table below summarizes the hardware features.

Amiga CD^{32} Hardware Features

- ❍ Top loading double speed CD-ROM drive
- ❍ 14MHz 68EC020 CPU
- ❍ Amiga AA graphics and sound chip set
- ❍ 2 Megabytes of 32-bit Chip RAM
- ❍ Two joystick ports
- ❍ S-video jack
- ❍ Composite video jack
- ❍ RF output jack
- ❍ Stereo audio jacks
- ❍ Keyboard connector
- ❍ Full expansion bus
- ❍ Volume control switch
- ❍ Headphone jack
- ❍ External brick power supply
- ❍ Internal MPEG Full Motion Video (FMV) expansion capability
- ❍ Optional computer module
- ❍ Multiple session disc capability

The AmigaCD^{32} Motherboard

The motherboard for the Amiga CD^{32} is roughly 6" by 12" and is a four layer board. On the main PCB is a 14MHz 68EC020, the AA chipset, an ASIC called Akiko, a DAC for playing standard CD audio, and a small amount of EEPROM.

Akiko is a 160-pin PQFP surface-mounted device containing most of the remainder of the logic necessary in the Amiga CD^{32}. It includes the CD-ROM control logic and the system timers. The EEPROM is 8K bits, and designed for storing settings, high scores, bookmarks, etc., on the Amiga CD^{32}.

In addition to the AA chips, Akiko, the CPU and the EEPROM, the main board contains 2MB of DRAM as Chip RAM. A PAL or NTSC modulator is also included on the main board.

When the optional computer or MPEG attachment is used, the composite video and RF outputs from the main system are not used. Both the computer and MPEG modules have their own video outputs. This allows them to mix Amiga CD^{32} video with the MPEG video or other genlocked source.

The Compact Disc DAC is a standard 18-bit, 8x oversampling DAC. Along with the superb audio quality of the DAC, the Amiga CD^{32} expansion connector has digital audio input capability in order to mix an external source such as MPEG audio with the CD audio and Amiga audio.

The Amiga AA Chip Set

The Amiga AA chip set is the latest in the Amiga family of custom chips. It provides stunning graphics and animation capabilities, a huge color palette and multiple display modes. Throughout the history of the Amiga, the individual chips of each chip set have had colorful names beginning with the trio of Portia, Agnus and Daphne in the original chip set up to the latest trio of Paula, Alice and Lisa contained in the Amiga CD^{32} system.

- ❍ Paula controls the I/O ports, potentiometer inputs, the audio hardware and interrupt control.
- ❍ Alice is the DMA controller. It generates DMA addresses, controls Chip RAM access, video timing and includes the blitter and copper (co-processor).
- ❍ Lisa is the video data chip. It provides the 16-million color palette, playfield scrolling, sprite control, joystick and Genlock support.

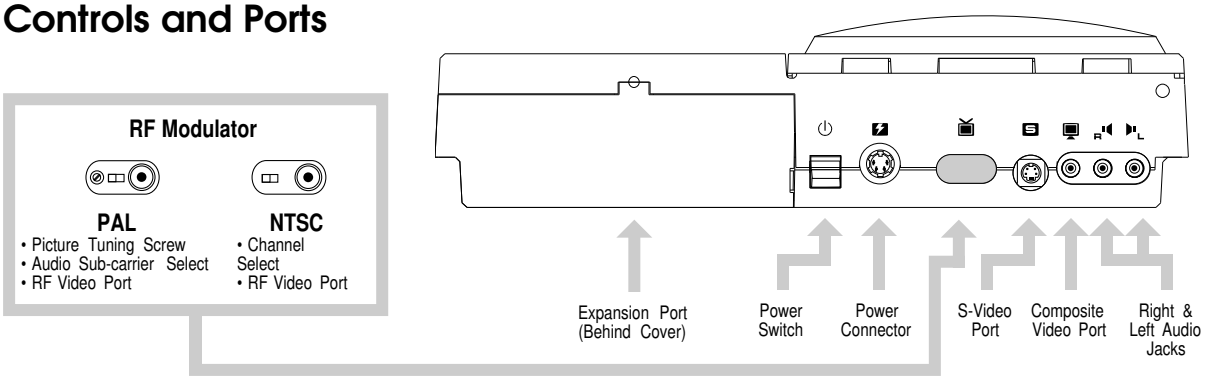
AA Chip Set Features

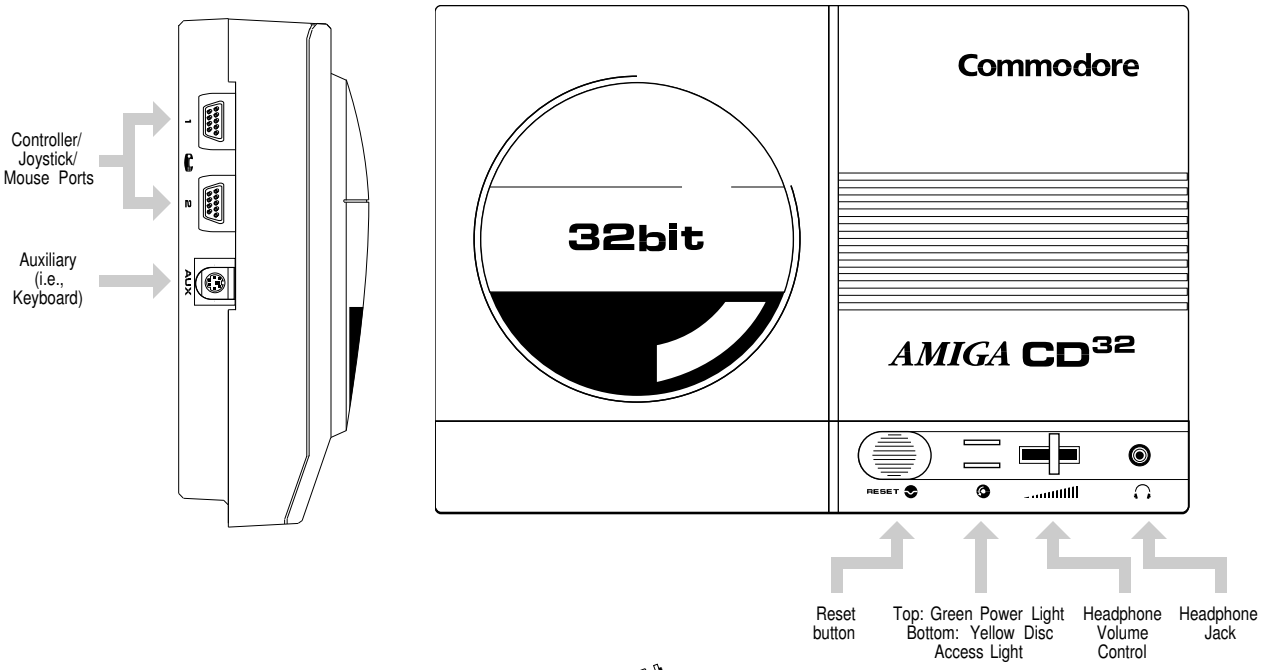
The AA chip set has a number of features that are ideal for games.

- 256 colors out of 16 million in all resolutions
- 32-bit wide Chip RAM and support for page mode DRAMs
- 8-bit HAM mode support (near true color display)
- Sprites are up to 64 bits wide
- Sprites can be displayed in the borders
- Attached sprites are available in all resolutions
- Dual 4-bitplane playfields
- Hardware scan-doubling support
- Hardware compatibility mode with the older Amiga ECS chip set
- Four-voice, 8 bit audio with variable sample rate

The AA chip set supports 15kHz and 31kHz display modes, but because AmigaCD^{32} will primarily be attached to a television set, the 31kHz modes are not used. These video modes can be used if the optional computer module is added with the RGB interface.

Controls and Ports





Amiga CD32 Comparison with other platforms

	3DO	Amiga CD32	SegaCD	NintendoCD
CPU/Speed:	ARM60/12mHz	68EC020/14mHz	2x68000/12mHz	65816/3.58mHz
Bits:	32 bit	32 bit	16 bit	8/16
MIPS:	6 MIPS	3.5 MIPS	0.3 MIPS	0.1 MIPS
Chip RAM:	1M VRAM	2M DRAM	64KB VRAM	Custom RAM??
Fast RAM:	1M DRAM	None	64KB SRAM	64KB SRAM
Non Volatile RAM:	Memory Card	1KB	8KB	Yes, ?KB
Custom Chips:	Two animation Processors Video Processor DSP, DMA Engine Exp. Controller	I/O ports, audio and interrupt controller DMA controller Video data controller CD-ROM controller	2 custom chips in base 3 custom chips in CD	5 custom chips in base 32-bit CD co-processor
Animation CELS:	Yes (100s)	8 Sprites (64 bit) & Bobs	80 Sprites (32 bit)	128 Sprites (64 bit)
Video Modes:	640x400, 15kHz	640x400, 15kHz	320x200, 15kHz	512x448, 15kHz
Colors:	256/32768	256,000/16 Million	64/512 colors	256/32768
Speed:	64M Pixels/sec	7M Pixels/sec	??	??
Sound:	Stereo 16 bit Stereo CD-DA DSP	Stereo 8 bit Stereo CD-DA DSP planned	Mono 8bit FM Stereo CD-DA No DSP	Stereo 16 bit Stereo CD-DA DSP
CD-ROM:	Double Speed Drawer Load MKE	Double Speed Top Loading Chinon/Sony	Single Speed Drawer Loading Sony	Double Speed ?? Mitsumi
Software License:	$3/disc	$3/disc	~$10/disc	~$10/disc
S/W Video Player:	Full screen 256 colors	Partial screen 4096 colors	Partial screen 16 colors	Full Screen 256 colors
MPEG:	Planned	Planned	No	No
PhotoCD:	In ROM	Planned	No	No
Video Frame Grabber:	Planned	Not Planned	No	No
H/W Warping	Yes	No	No	Yes
H/W Transparency	Yes	No	No	No
H/W Lighting Effects	Yes	No	No	No
H/W Anti-Aliasing	Yes	No	No	No
H/W Texture Mapping	Yes	No	No	Yes
Game Controller:	8 buttons	11 buttons	8 buttons	12 buttons
Parallel/Serial:	Planned	Planned	No	No
Floppy/Hard Drive:	Not Planned	Planned	No	No
Keyboard/Mouse:	Planned	Planned	No	Planned Mouse
Computer Expansion:	Not Planned	Yes	No	No
Development System Cost:	$10,000+	$3,000	?	?
Partners:	Matsushita Time Warner AT&T	None	JVC (WonderMega) Pioneer	None
Suggested Retail Price	$699	$399	$299+$99	$??+$99
Availability	Christmas goal	June 1993	Now	1994

2 Producing Titles

Producing titles for the CD game machine platform is a little different than the method you might use for floppy-based titles. The basic steps are as follows:

1. Get a development system (A4000 with a hard drive).
2. Develop or port game.
3. Create an ISO image of the game with ISOCD. Test with SimCD and OPTCD on an A4000.
4. Create the gold (master) disc from the ISO image.
5. Test the gold disc on a prototype CD game machine.
6. Repeat steps 2-5 until ready for duplication.

Development Systems

An Amiga 4000 with an '040 CPU is a good development platform. The A4000 has the AA chip set so the underlying hardware will be the same as the game machine. The '040 processor means that you will be able to use debugging tools such as Enforcer that require an MMU.

You should use the MapROM command with the V40 developer Kickstart release to make the A4000 more like the game machine operating system. MapROM also allows you to upgrade as new V40 Kickstarts are released (no ROMs or EPROMs required).

The IDE disk drive bundled with the A4000 gives a reasonable approximation of CD-ROM speeds. For faster, larger hard drives, use a 4091 or 2091 SCSI controller and a SCSI drive. (If you use the 2091 controller board, it must have the 7.0 ROM set to work properly with the A4000.)

Since the CD game machine has a 68EC020 processor, you may also want to have an an Amiga 1200 for accurate performance testing of your product prior to mastering. The A1200 has an '020 processor and the AA chip set just like the Amiga CD^{32}. However be aware that MMU-based debugging tools such as Enforcer will not work with the '020 processor. Another alternative is to use the Amiga 4000 with an '020 CPU. A special plug-in card that has both '020 and '030 processors on it is available from Commodore in limited quantities (contact your local support office).

The Amiga CD^{32} game machine is shipped with Chip RAM only. For testing, you should use either the NoFastMem command (do this early in your startup-sequence) or remove all Fast RAM from your test system so that your code loads into Chip memory only. Keep in mind that Amiga CD^{32} memory can be expanded so your code should be able to run with Fast memory too.

Prototype CD Systems and the Debug Board

Prototype CD systems are avilable in limited quantities that allow you to test gold (master) discs. The prototype consists of a motherboard, game controller, CD-ROM drive and a special development plug-in card that has serial, parallel, RGB, IDE and floppy connectors. This plug-in card is officially known as the "Debug Board".

With the debug board you can run and test your code off of an IDE hard disk drive (or floppy disk). The debug board plugs into the expansion edge card connector at the rear of the game machine motherboard. The operation of the ports and their physical connectors are identical to the standard Amiga I/O ports.

Floppy drive

Supports any standard Amiga drive (A1010, A1011). Do not plug or unplug drives from this port with the power on. The 8520s connected to this port are very static sensitive and can be easily damaged this way. This port has the highest boot priority.

Parallel port

Identical to other Amiga parallel ports.

Serial port

Identical to other Amiga serial ports except that Ring Indicate is not supported. This is useful for serial port debugging with the debug.library and other tools such as Enforcer.

IDE Interface

This can support any size IDE hard drive with a 40-pin interface connector. A separate power supply must be provided for the hard drive. The connector is not keyed so carefully note the pin 1 orientation. This interface is memory-mapped I/O, not DMA, so it is relatively slow. The hardware implementation on the debug board is even slower than an A1200 IDE interface so you may notice some exceptionally long boot times from hard disk.

Emulator

The socket on the debug board labelled U1 allows you to connect a 68020 In-Circuit-Emulator pod to the system. The 68020 ICEs can be used in place of the 68EC020 without any problems. To enable the emulator, short the two pads of XJ1 on the debug board together. (This asserts a bus request signal to the 68EC020 processor on the main board disabling it.)

Patch RAM

This optional RAM may or may not be installed on your board (depending on its vintage). This is 512K bytes of static RAM located at $F0 0000 used for patching the operating system firmware. It is not needed for normal debugging operation.

RGB video

This is analog RGB. The connector may or may not be present on your board (depending on its vintage) but the pinout is identical to Amiga video, so a cable could be hard-wired to the board. If this is too much trouble, use the S-video signal from the main PCB; it is nearly as good as the analog RGB.

Note that the prototype systems require the debug board in order to operate. The prototype systems cannot boot without the 8520 CIAs that are part of the debug board. Installation of the debug board should be done with caution. It requires a good deal of force to insert the board and the pins inside the connector are fragile. Once bent, the pins cannot be straightened.

Development Tools: ISOCD, SimCD and OPTCD

There are three development tools that can help you in your effort to make CD titles:

ISOCD - Creates an ISO-9660 image file suitable for making the gold (master) disc. Prepares a partition for use with SimCD.

SimCD - Emulates the CD-ROM drive (CD0:) from a partition prepared with ISOCD. This allows you to test the integrity of your ISO image without having to cut a gold (master) disc.

OPTCD - Optimizes the arrangement of data on a CD to minimize seek times and improve performance.

ISOCD, SimCD and OPTCD are all part of the ISO Tools Disk available to any licensed Amiga CD^{32} developer. With ISOCD, SimCD and OPTCD you can create and test the integrity of ISO images on hard disk before taking the time and expense to cut a gold (master) disc.

ISOCD has two purposes. It prepares a partition for use with SimCD and it also can produce the ISO-9660 image file you need in order to create the gold disc. The basic steps to using ISOCD are as follows:

1. Set up a partition of the appropriate size on hard disk named CDN:. (Do not call it CD0:. That name is reserved.)

2. Run ISOCD. Click on the Source gadget to specify the source directory containing your program and data files.

3. Click on the Image gadget to specify the target partition to use for the ISO image. Only specify a file name for the image if you are ready to cut a gold (master) disc.

4. Click on the Examine gadget. A list of files is displayed. (Do not use the "Add Empty Space" feature with V1.00; it is broken. This option works in 1.03 and later.)

5. Click on the Build gadget. Exit.

SimCD sets up a simulated CD-ROM drive named CD0: using the ISO image set up previously with ISOCD. With SimCD, you can check to see if the ISO-9660 version of your application will work. There is no need to cut a disc. The steps to using SimCD are:

1. Make a directory called devs:Local. Copy devs/local/cdtv.device from the ISO Tools disk into devs:Local.

2. Make a directory called l:Local. Copy l/local/cdfs from the ISO Tools disk into l:Local.

3. Make 2 assignments. Assign devs: devs:Local add. Assign l: l:Local add.

4. Load SimCD. Under Configuration, select CDFS and cdtv.device only.

5. Set "Sim Device" to CDN: and hit the Simulate button.

6. SimCD sets up a simulated CD0: drive using the ISO image on CDN:. Move to the directory CD0: and run your startup-sequence or executable.

Warning:
SimCD emulates the older cdtv.device driver used in Commodore CDTV systems. Commodore is working to upgrade this important tool so that it emulates the new cd.device driver used in the CD game machine. Until then, be aware that SimCD cannot be used to test code that directly calls the cd.device. Also, SimCD emulates the slower speeds of the CD-ROM drive used with CDTV. Your title on disc will be faster.

Once you have tested your application in its ISO-9660 version with ISOCD and SimCD, you are ready to create the gold (master) disc.

Trademark File

In order to get a title to boot on an AmigaCD^{32} console, a special AmigaCD^{32} trademark file must be included directly after the PVD sectors. CDTV supported a similar trademark file either right after the PVD sectors or in a normal file in the root of the CD directory structure. This is not the case with AmigaCD^{32}, the trademark file must always be included after the PVD sectors.

The AmigaCD^{32} trademark file differs from the CDTV one. The AmigaCD^{32} system relies on the differences in the trademark files to determine if a title is a CDTV title or an AmigaCD^{32} title. Contact CATS for information on obtaining the trademark file if you plan on generating your own ISO image. In order to ensure the trademark file gets placed directly after the PVD sectors, do not simply copy it to your CD's directory. Instead make sure that the trademark file is in the directory you are currently CD'd to (probably where ISOCD is located) when creating your ISO image.

Note that use of the trademark file requires an AmigaCD^{32} license agreement with Commodore. Contact CATS for licensing information.

The type of trademark file on a CD determines the environment in which the title is started. If a CDTV trademark file is found, the title is booted in ECS mode. If an AmigaCD^{32} trademark is found, the title is booted directly in AA mode. In addition, many system patches are applied on a per-title basis when booting CDTV titles in order to keep them working on the AmigaCD^{32}.

Creating the Gold Disc

CD manufacturing companies make a gold (master) disc before they produce your title in large quantities. This step is known as pre-mastering and can usually be performed by the same company that produces the discs in quantity.

For a limited time, Commodore will help you create the gold disc. This service is provided to shorten the amount of time it takes to bring your product to market. (It is OK to use a pre-mastering service of your own choosing if you prefer.)

To take advantage of this service, send the ISO image of your application on DAT tape to the Maidenhead office in the U.K., care of Sharon McGuffie. A gold disc will be created and, if it works, an additional disc will be created for examination by Commodore, West Chester. In the U.S., send the DAT tape directly to the West Chester office care of John Kominetz.

The gold disc will be returned to you as quickly as possible so that you can test it on a prototype CD game machine prior to manufacturing it in quantity. When the gold disc is created, any protection bits or script bits you have set for your files will be lost since these are not supported by the ISO-9660 standard. Be sure to avoid counting on the presence of these bits in application code.

There are a variety of ways to convey your ISO image to the pre-mastering service. Depending on the vendor, you might send off a hard disk, a DAT tape containing a copy of the ISO, 1/2" U-Matic video tape -- some vendors even accept floppies. If you use Commodore for your pre-mastering service, try to provide your ISO image on DAT tape, if possible. Other formats will take longer. If you do not supply an ISO image on DAT tape, be sure to include the volume name you want to use for the CD-ROM disc.

Manufacturing CD-ROMs

While it is possible to create a "master-stamper" directly from the gold (master) disc, most replication centers prefer to to receive a 9-track tape. This master tape is an ANSI-labelled, 9-track, 1/2" tape containing the ISO-9660 image of your code and data. This can be prepared by you or by the service that created the gold disc.

The CD manufacturer will transfer the tape to a laser beam recording system which creates the master stamper. The stamper presses CDs from molten polycarbonate which is subsequently coated with aluminum and a protectant. Labels are added and the disc inserted into a jewel case or other packaging.

In the U.K., the recommended vendors for volume production of your CD-ROM based application are:

SonoPress
26/27 Conduit St.
London W1R 9TA
Voice: 71 499 6813
Fax: 71 493 7244

Nimbus
Wyastone Leys
Monmouth
Gwent NP5 3SR
Voice: 600 890 682
FAX: 600 890 779

Pricing is subject to negotiation and volume but a rough rule of thumb is:

Mastering:	£ 900
Set up:	£ 200
Per disc:	£ 0.90 to 1.50

There are many other vendors you can choose to work with. Here is a brief list to get you started in your search:

3M Optical Recording Department
3M Center 223-5S-01
St. Paul, MN 55144-1000
Telephone (612) 736-5399
Fax (612) 733-0158
Sales contact: Don Winklepleck, (603) 595 0391
Technical contact: Andy Axelsen, (800) 336 3636
Fax: (715) 235 0500
Territories served: North and South America, Europe, Far East
Preferred source format: 8mm Exabyte, 4 mm DAT, 9 Track, MO, Hard Disk, CDWO, 3480, DC6150 (QIC)
One-off service available: Call
Terms of business: Net 30 days
Pre-mastering and CDTV ISO building: Call

Advanced Media Group, Ltd.

P.O. Box 1623
Lancaster, PA 17603
Telephone:(717) 392-6533
Fax: (717) 392-0532
Sales contact: Stan Caterbone
Technical contact: Stan Caterbone/Mike Hess
Territories served: North and South America, Europe, Far East
Preferred source format: Tape, hard disk, any media accepted upon prior approval
One-off service: No
Terms of Business: Upon invoice Net 30 with prior approval
Pre-mastering and CDTV ISO building: No

Americ Disc Inc.

2525 Canadien
Drummondville, Quebec
Canada J2B8A9
Telephone: (819) 474-2655
Fax: (819) 474-2870
Sales contact: A. Frank Johansen
Technical contact: Peter Frame
Territories served: Canada, USA, South America
Preferred source format: 8mm Exabyte, 9 track tape, CD-ROM
One-off service: No
Terms of Business: Net 30 days on credit approval
Pre-mastering and CDTV ISO building: No

Attica Cybernetics Ltd.

Unit 2 Kings Meadow
Ferry Hinksey Road
Oxford, England OX2 0DP
Telephone: 44-865-791-346
Fax: 44-865-794-561
Sales contact: Gill Diskson
Technical contact: Ian Ellison
Territories served: Worldwide, from UK office
Preferred source format: AmigaDOS file on SCSI drive. Other options available
One-off service: Call
Terms of Business: Payment in advance; credit for UK companies by arrangement
Pre-mastering and CDTV ISO building: Call

Clarinet Systems Ltd.

White Hart House
London Road
Blackwater, Camberley, Surrey, UK
Telephone: 44-276-600-398
Fax: 44-276-600-592
Sales contact: Stephen Schoiefield
Technical contact: Chris Simmonds
Territories served: UK, Europe
Preferred source format: Hard disk, DAT, floppy, Exabyte, 1/2 inch tape
One-off service: Available
Pre-mastering and CDTV ISO building: Available

Digipress, U.S.

2516 River Bend Drive
Louisville, KY 40206
Telephone: (502) 895-0565
Contact: Dennis Oudard

Digipress, Europe

10 rue de Paris
78100 Saint-Germain-en-Laye, France
Telephone: 33-1-30-61-11-00
Contact: Marc Deflassieux

Digital Audio Disc Corporation (DADC)

1800 N. Fruitridge Ave.
Terre Haute, IN 47804
Customer service Telephone: (812) 462-8192
Customer service Fax: (812) 466-2007
Sales contact: Bob Hurley, Voice: (603) 595-4331 Fax: (603) 595-4310
Technical Contact: Cliff Brannon, Voice: (812) 462-8286, Fax: (812) 466-9125
Territories served: USA, Europe, Far East
Preferred source format: 9 track tape, MO, 8mm, 4mm, CD WO
One-off service: Available
Terms of Business: 1% 10 Net 30
Pre-mastering and CDTV ISO building: Available soon

Discovery Systems

7001 Discovery Boulevard
Dublin, OH 43017
Telephone: (614) 761-2000
Fax: (614) 741-4258
Sales Contact: Greg Tiller
Technical Contact: Alex Deak, Customer Service
Territories served: North America, Europe, Australia
Preferred Source format: 9 track or 8mm tape, call for additional options
Terms of business: 90 days net
One-off service: Available
Pre-mastering and CDTV ISO building: Yes

Disc Manufacturing, Inc., International

A Quixote Company
4905 Moores Mill Rd.
Huntsville, AL 35810
Telephone: (205) 859-9042
Fax: (205) 859-9932
Sales contact: Kim Vandenberghe
Technical contact: Shogo Karitani
Territories served: North and South America, Europe, Far East
Preferred Source format: 8mm Exabyte, Pinnacle MO, One-off CD, 9-track tape
One-off service: Call
Terms of Business: Net 30 days, on credit approval
Pre-mastering and CDTV ISO building: Call

Disc Manufacturing, Inc., U.S.

1120 Cosby Way
Anaheim, CA 92086
Telephone: (714) 630-6700
Fax: (714) 630-1025
Sales contact: Wan Seegmiller
Technical contact: Leon Whidbee

Elektroson

Velderseweg 25
5298 Le Liempde
The Netherlands
Telephone: 31-4113-3021
Fax: 31-4113-2763
Sales and technical contact: Dr. R.C.H. Broers
Territories served: Europe
One-off service: Yes
Pre-mastering and CDTV ISO building: Yes

M.P.O.

195 Ave. Charles de Gaulle
92200 Neuilly Sur Seine
France
Telephone: 331-4722-2000
Fax: 331-4722-6077
Sales contact: Bruno d'Orgeval
Technical contact: Marc des Rieux
Territories served: USA/Canada (Disc Americ), Europe (MPO), Spain (Techno-CD)
Preferred Source Format: Video 8mm
One-off service available: Yes
Terms of business: 60 days
Pre-mastering and CDTV ISO building: Yes

Multi-Media Masters Machinery SA

Av. des Sports 42
CH - 14000 Yverdon-Les-Bains
Switzerland
Telephone: 41-24-23-71-11
Fax: 41-24-23-71-12
Sales contact: Gregory Koler
Technical contact: Albert Khoury
Territories served: Europe, USA if required
Preferred Source Format: 9-track tape, 8mm Exabyte, 1/4" U-Matic, DAT, 5.25" Optical
One-off service: Call
Terms of business: Net 30 days
Pre-mastering and CDTV ISO building: Call

Next Technology Corporation Ltd.

St. John's Innovation Center
Cambridge
Cambridgeshire CB4 4WS
U.K.
Telephone: 44-223-420-222
Fax: 44-223-420-015
Sales contact: Ian Thomas
Technical contact: Neil Critchell
Territories served: Europe
Pre-mastering and CDTV ISO building: Yes

NEXT specializes in pre-mastering and CDTV ISO building services.

Nimbus Information Systems, U.S.

SR 629, Guildford Farm
Ruckersville, VA 22968
Telephone: (804) 985-1100 or (800) 782-0778
Fax: (804) 985-4625
Sales contact: Larry Boden
Technical contact: Ernest Runyon

Nimbus Information Systems, Europe

Wyastone Leys
Monmouth
Gwent NP5 3SR
United Kingdom
Telephone: 44-600-890-682
Fax: 44-600-890-779
Sales contact: Steve Connoly
Technical Contact: Jim Orr
Territories served: USA and Europe
Preferred source format: 4mm DAT or 8mm Exabyte
One-off service: Call
Terms of business: Net 30 days, upon credit approval
Pre-mastering and CDTV ISO building: Call

On-Site CD Services

13901 Lyndie Ave.
Saratoga, CA 95070
Telephone: (408) 867-0514
Fax: (408) 867-0518
Sales contact: Rick Wittwer
Technical contact: Lance Buder
Territories served: USA
Preferred source format: 8 mm, ANSI labeled image or hard disk
One-off service : Call
Pre-mastering and CDTV ISO building: Call.

On-Site is a pre-mastering specialist, located in California. They do not replicate discs in quantity.

Optical Media Storage S.P.A.

Localit' Campo di Pilek
67100 L'Aquila, Italy
Telephone: 39-862-3311
Fax: 39-862-315366
Technical contact: Antonio Bruno
Territories served: Europe
Preferred source format: 9-track tape, hard disc, CD-WO, CD-ROM ISO image
One-off service: Call
Pre-mastering and CDTV ISO building: No

Phillips and Du Pont Optical

1409 Foulk Road, Suite 200
Wilmington, DE 19803, USA
Telephone: (302) 479-2501
Fax: (302) 479-2512
Sales contact, USA: Joe Bradley, Voice: (301) 989-9341
Technical contact: Jim Fricks, Voice: (704) 734-4211
Territories served: USA and Europe
Preferred source format: 8mm, 9-track tape, one-off CD
One-off service: available in USA
Pre-mastering and CDTV ISO building: USA only

P.D.O. offers pan-European services. Here are contact addresses and numbers in other countries:

PDO Headquarters

Building EF-2
P.O. Box 218
5600 MD Eindhoven, Netherlands
Telephone: 31-40-751120
Fax: 31-40-757866

PDO Technical Support---Europe

Klusriede 26
D-3012 Langenhagen 1, Germany
Telephone: 49-511-7306-253
Fax: 49-511-7306-694

PDO sales office for Benelux and Italy

Building EF-2
P.O. Box 218
5600 MD Eindhoven, Netherlands
Telephone: 31-40-751120
Fax: 31-40-757866

PDO sales office for the UK, Ireland and Scandinavia

Queen Anne House
11 The Green
Richmond upon Thames
Surrey TW9 1PX, UK
Telephone: 44-81-948-7368
Fax: 44-81-940-7137

PDO sales office for France and Spain

43 Avenue Marceau
F-75116 Paris, France
Telephone: 33-1-4070-1123
Fax: 33-1-4070-1126

PDO Sales office for Germany, Austria and Switzerland

Adenauerallee 32
D-2000 Hamburg 1, Germany
Telephone: 49-40-280-1391
Fax: 49-40-280-1785

Sonopress GmbH

Carl-Bertelsmann-Str. 161
D-4830 Gutersloh 100, Germany
Telephone: 49-5241-803074
Fax: 49-5241-73686
Sales contact: Dr. Reinhard Raubenheimer
Technical contact: Ulrich Graznow
Telephone: 49-5241-805250
Fax: 49-5241-75863
Territories served: all European countries, USA if required
Preferred source format: 9-track tape, Exabyte, SCSI harddisk, Audio input media Sony 1610/1630 One-off service: Call
Terms of business: Based on customer requirements
Pre-mastering service: Call

Sonopress provides pan-European services. Here are contact names and numbers in other countries.

Sonopress UK

26/27 Conduit Street
London W1R 9TA
Sales contact: Sabine Leuerer
Telephone: 44-71-499-6813
Fax: 44-71-493-7244

Sonopress France

Sales contact Madame Bornhold
Telephone: 33-1-45-636707
Fax: 33-1-43-596673

Sonopress Italy

Sales contact Dr. Paolo Montagna
Telephone: 39-2-7600-4737
Fax: 39-2-7601-5026

Disc Packaging and Graphics Standards

Before your title goes into production, you will need to determine its packaging. Will your discs be packaged in jewel cases? Do you plan to have any outer packaging for your disc cases? What about additional documentation, reference cards and promotional materials? All of this should be determined before hand, since most duplication houses requires packaging or packaging specs prior to or with a disc production order. Some dics duplicacators provide design and printing services, relieving you of this burdon.

The packaging decision is yours, all that Commodore asks is that you try to adhere to it's graphics standards. This section provides the information needed to present a unified image to the public. A universal standard for the visual identity of all Amiga CD^{32} products.

The Logos

The Amiga CD^{32} logo is the foundation for the entire identity program. It consists of the of the Amiga CD^{32} logo type and the "TM" symbol. These elements should *never* be altered from the form shown below, except as specified in this publication. The logo's attributes are as follows:

- The Amiga CD32 logo must appear on a 100% black background.
- "Amiga" and "32" and the "TM" symbol print in PMS red 485 or equivalent. If the logo is to appear in only black & white, the previous words should be printed in a 20% black screen.
- "CD" is a white knockout (or prints in white)
- In most cases, the logo should be positioned horizontal in the upper left corner of the package.

In most instances the Commodore logo should appear in conjunction with the main Amiga CD^{32} logo. When this is the case, the Comodore logo should have the following attributes:

- "Commodore" is a white knockout (or prints in white)
- It is always positioned to the left of Amiga CD^{32}, in the upper right corner of the package.
- The top of the logo lines up with the top of the "32" in the Amiga CD^{32} logo.
- The minimun black space beween the two logos is one full length of the Commodore logo.

ALWAYS USE PHOTOMECANICAL REPRODUCTIONS OF THE LOGOS.

NEVER...

- **Use photocopies of the logos.**
- **Attempt to redraw or re-create the logos yourself.**
- **Reproduce the logos from the diagrams or templates in this manual.**

Reproducable "stats" can be aquired from Sue West of the CATS department. Logos are also available in Encapsulated Postscript format for use in creating packaging on desktop publishing computer systems.

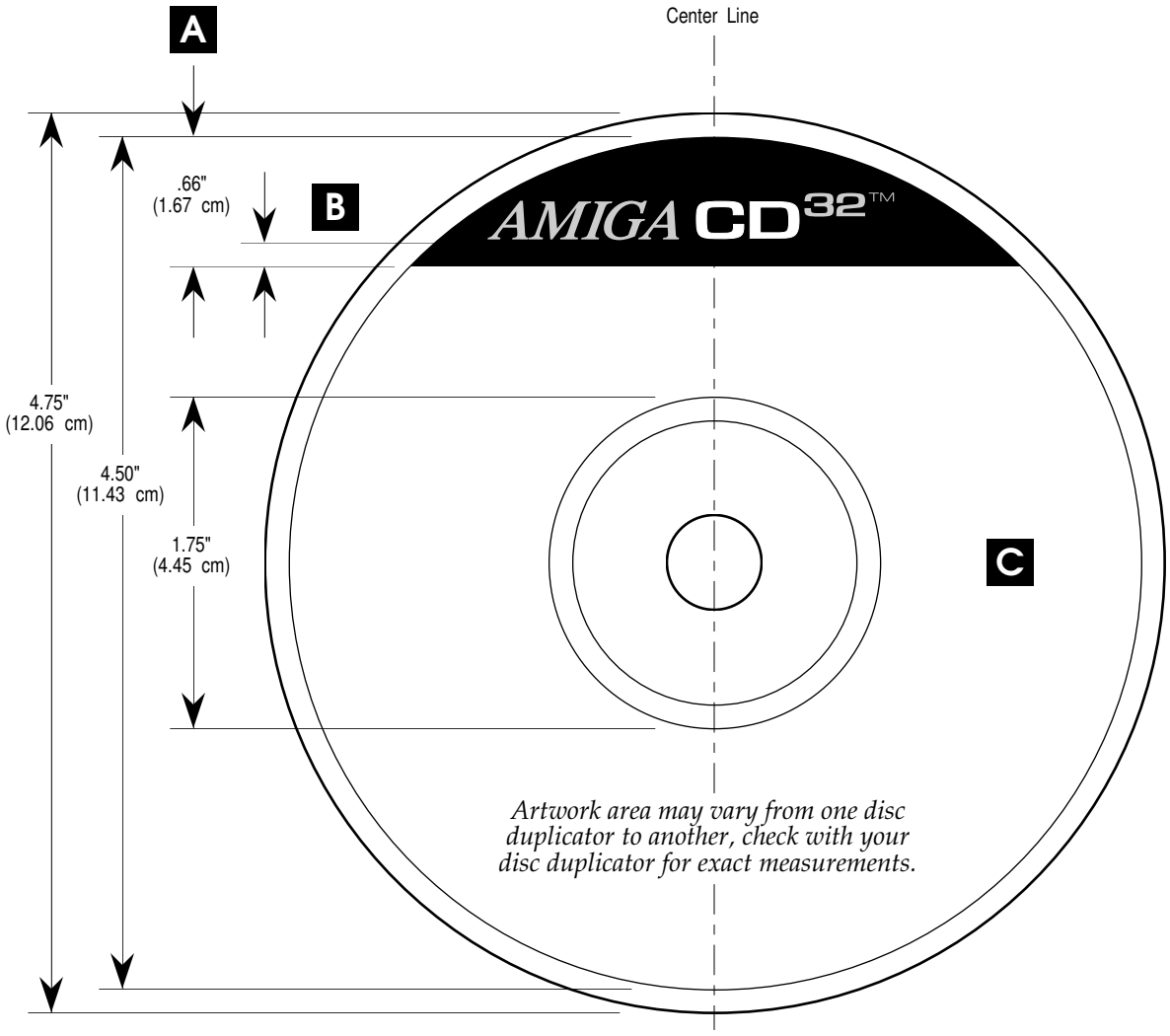
Disc Graphics

Below is the proper application of graphics on the face of the disc itself. The only specification is the consistent application of the Amiga CD^{32} logo over a black bar.

A **TOP BAR:** A band of 100% black, .66" tall to the edge of the disc's graphic area.

B **AMIGA CD^{32} LOGO:** Centered horizontally within the top bar.

C **FOR PUBLISHER USE:** The remaining 4 1/2" DIA. area is free to use for title graphics



Logos and graphics are provided for position and size only.
DO NOT REPRODUCE FROM THIS DIAGRAM.
See section on Reproduction Proofs.

Cover Insert

The cover insert is either a single sheet or a multipage booklet placed inside the jewel case cover. For the purpose of these standards, Commodore is only concerned with the placement of it's graphics on the front cover portion of the insert.

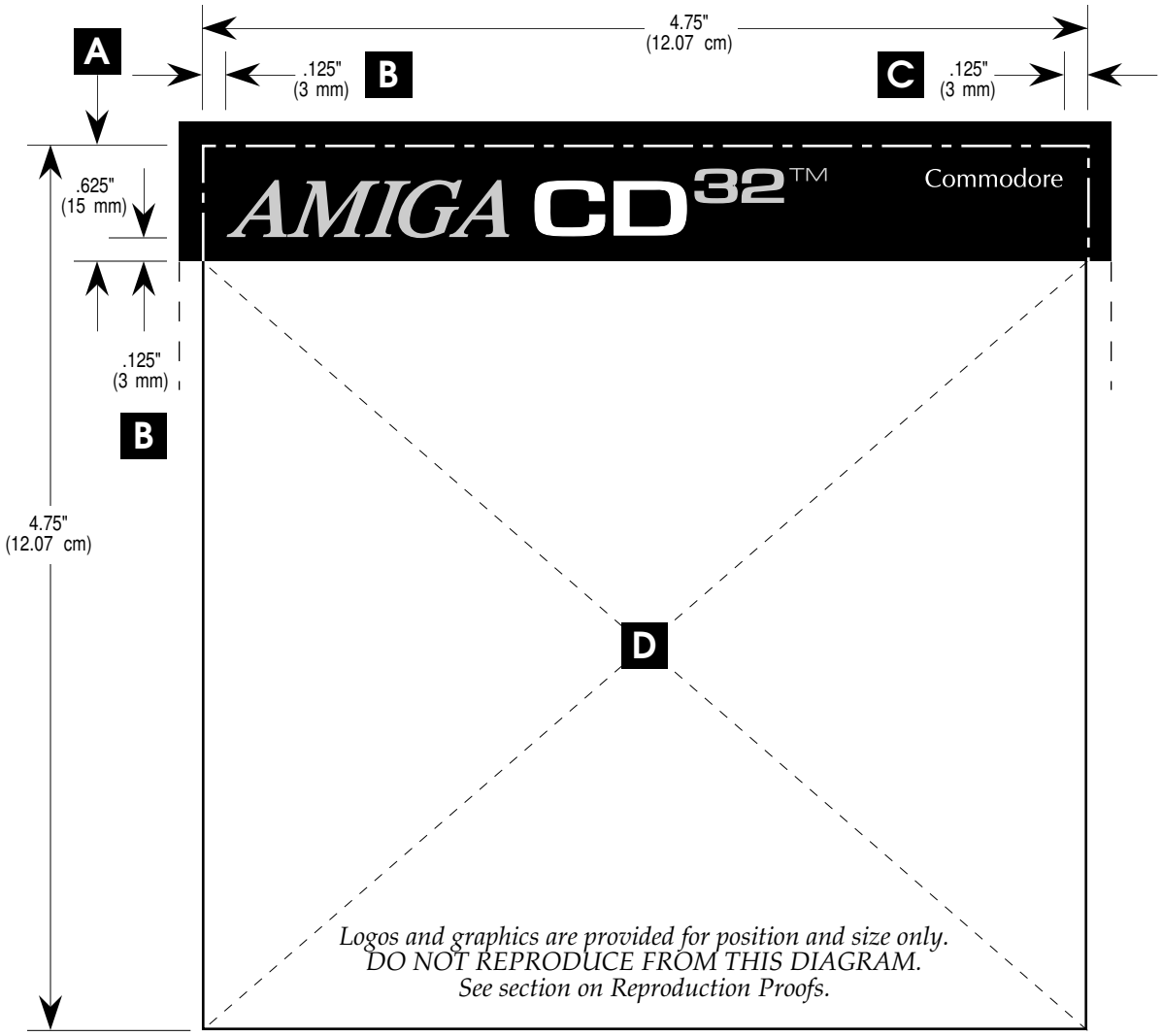
Before designing the cover insert and choosing paper stock, check with your disc duplicator for exact measurements and paper requirements. This will avoid jamming or damage during insertion.

A **TOP BAR:** A band of 100% black, 5/8" tall should bleed off the top and both sides of the card.

B **AMIGA CD32 LOGO:** Positioned as shown.

C **COMMODORE LOGO:** positioned so that the top lines up with the top the Amiga CD32 logo.

D **FOR PUBLISHER USE:** The area within the dashed borders is free to use for title graphics.



Inlay Card Graphics

The inlay card is a flat sheet of paper which is scored and folded approximately 1/4" from both the left and right edges. When encased inside a jewel case, it becomes the graphics for the back and side panels. For a double CD jewel case, an identical inlay card is required for front and spine artwork.

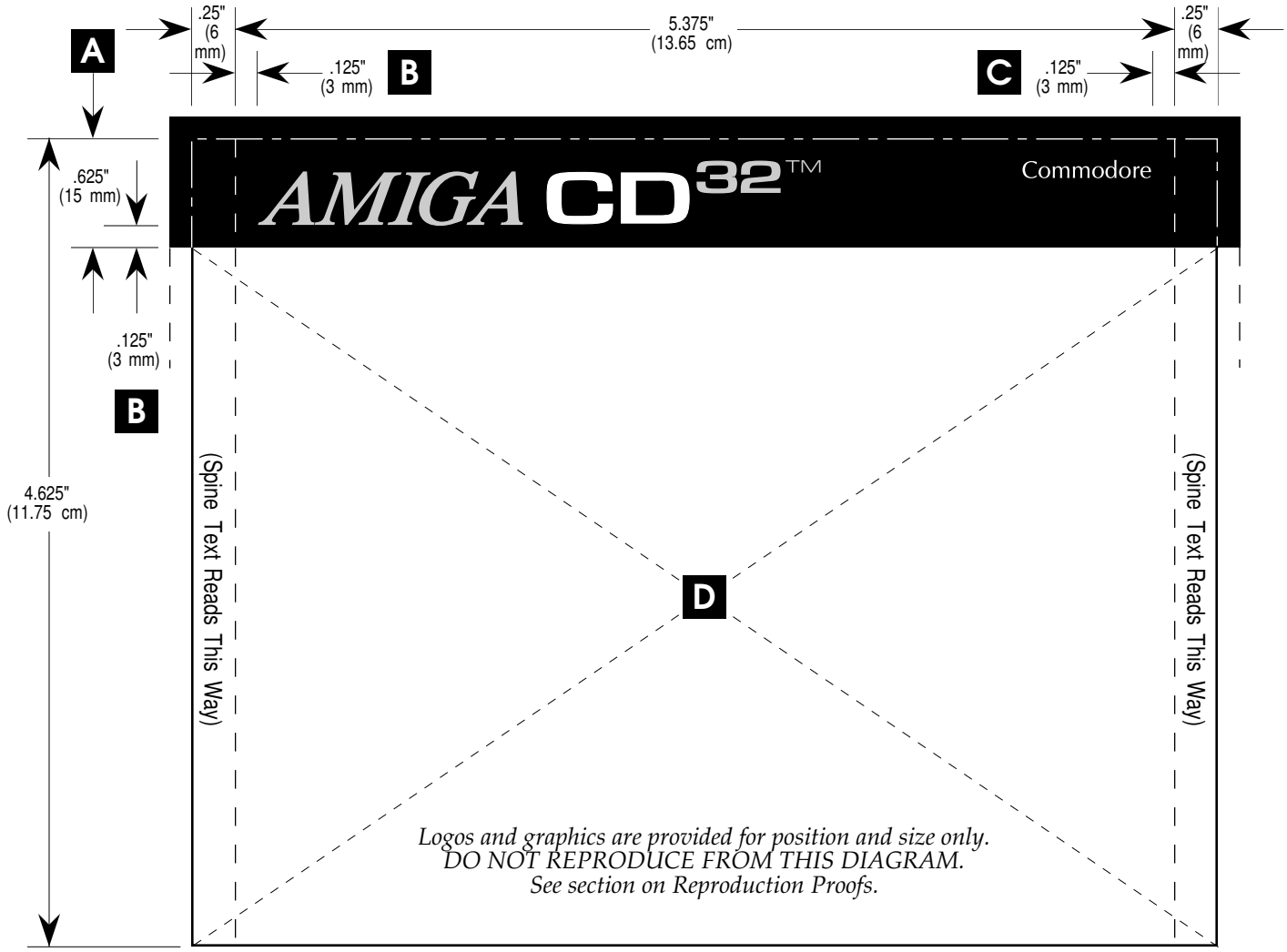
Before designing the inlay card and choosing paper stock, check with your disc duplicator for exact measurements and paper requirements. This will avoid jamming or damage during insertion.

A **TOP BAR:** A band of 100% black, 5/8" tall should bleed off the top and both sides of the card.

B **AMIGA CD^{32} LOGO:** Positioned as shown.

C **COMMODORE LOGO:** positioned so that the top lines up with the top the Amiga CD^{32} logo.

D **FOR PUBLISHER USE:** The area within the dashed borders is free to use for title graphics.



3 Writing OS-Friendly Games

Many Amiga programmers believe that the only way to write a whiz-bang, speed-of-light game is to bypass the operating system and go straight to the hardware. A better approach is to write games that are OS-friendly. The combination of the AA chipset and the latest V40 system software make system-friendly solutions more possible than ever.

Why Use the Operating System?

Here are some reasons to use the OS for games:

- OS code runs out of ROM, which is faster than running equivalent code out of Chip RAM.
- Why reinvent the wheel? Spend your time doing things that only you can do.
- The OS automatically supports pre-ECS, ECS, and AA (and will support the next revision of the Amiga chip set).
- There is less code to write. The OS has routines for handling all screen positions and scrolls, mouse movement, etc. This means less development time and less time getting the hardware to work, and more time making the game more playable.
- More robustness. For instance, the OS floppy disk code is far less picky about drive parameters than 99% of custom floppy I/O code.
- Hides bugs and quirks of the chip set. The AA chip set has a few bugs which the OS hides from you.
- Multiple platforms. OS code will run on all Amiga-based machines, whatever their flavor.
- Compatibility with future chipsets. The next revision of the Amiga chip set will not be register-level compatible with AA.

Things the System Cannot Do

A long-term goal of the Amiga operating system is to support the common display tricks often used in games. There are some things that can't be done though:

- Scrolling individual scan lines of a ViewPort
- Using a copper list to fade a AA color register
- Dynamic updating of user copper lists.

All these are planned to be addressed in future OS releases. The goal is to allow these and other types of operations within normal Intuition screens if possible.

ECS-to-AA Incompatibilities that the OS Handles

If you are coding for the AA chip set (and you ought to be) the OS handles some problems of backward compatibility with the older ECS chip set that you do not want to deal with.

- Vertical counter behaves differently in programmable beam modes.
- No SuperHires color scrambling.
- Bitplane alignment problems.

Compatibility Beyond AA that the OS Handles

The successor to the AA chip set will not be register-level compatible. To minimize the side-effects, the operating system will have features designed to hide any incompatibilities from programs that use system calls. Hence, using the operating system for display operations is the best way to ensure a measure of forward-compatibility with chip sets to come.

Some of the problems the system will handle for you are:

- Future chip sets will have no fetch-mode selections. All selections will be automatic.
- Different DDFSTART/STOP calculations for single/dual systems.
- Color loading will be different
- Exact copper timings will be different
- No SuperHires
- Multiple blitters

Booting A Title

AmigaCD^{32} boots just like a normal Amiga. The only available boot device is normally the CD (CD0:), so the system boots off the CD in the same manner it would boot from a hard-drive, executing a startup-sequence and so on. In order to boot, your title must have the Commodore trademark file right after the PVD sectors (see chapter 2 for more on this.)

Competing game consoles generally have instantaneous startup times for titles, due to the cartridge interface used. AmigaCD^{32} benefits in many ways from its CD-ROM technology, however booting time is not one of these benefits. Due to the very slow seek times of CD-ROM devices, the dynamics of disk I/O are quite a bit different from a hard drive. It is crucial that developers be aware of this situation and take appropriate action to reduce boot times.

The startup animation sequence provided by the AmigaCD^{32} ROM has some continuous motion to indicate that the system is doing something while a title is booting. This animation sequence requires little memory and gets out of the way as soon as the title is ready to run. This animation helps eliminate the long periods of black screen familiar to CDTV users.

An important factor in bootup time is the length of the startup-sequence executed by the system prior to running a title. The startup-sequence shipped with standard Amiga systems is intended for use in a multitasking computer environment. Understanding the startup-sequence, and optimizing it can help reduce bootup time considerably.

The following is a startup-sequence which is adequate for most titles. It is much smaller and many times faster than the standard startup-sequence provided with Workbench 3.1. It also leaves noticeably more memory for your title than when the standard startup-sequence is used.

```
C:SetPatch QUIET

    ; Only include this line if you are using locale.library
    C:Assign >NIL: LOCALE: SYS:Locale

    ; here you can add any assignments that are specific to your title.
    C:Assign >NIL: WestChesterWarrior: SYS:WestChesterWarrior

    ; Only include these lines if you include the corresponding monitor files
    ; on your disc. Only include the files on the disc if you actually use the
    ; modes these monitors provide. Each monitor included eats up memory
    ; and takes time to load and run.
    DEVS:Monitors/NTSC
    DEVS:Monitors/PAL
    DEVS:Monitors/DblNTSC
    DEVS:Monitors/DblPAL

    ; here you just start your title
    SYS:WestChesterWarrior
```

Note that using explicit path specifications (C:Assign instead of just Assign) avoids a lot of head seeking and can improve startup performance.

Note also that use of Workbench files on a CD (other than plain text files such as the startup-sequence) requires a Workbench License Agreement with Commodore. Contact CATS for licensing information.

Another important consideration in bootup time is the size and complexity of the title itself. It is highly desirable to get your title on the screen as soon as possible. This can become difficult with very large titles which take a long time to load. The solution to this problem involves either the use of overlays, or the use of a separate loader program.

The simpler approach is the loader program. This is a very small program that gets run in the startup-sequence (just like WestChesterWarrior in the example above). This loader program contains some animation and music sequences that can quickly be put onto the screen. While this animation is playing, the loader program can then proceed to load the rest of the title into memory and activate it. See the DOS RunCommand() or System() functions for information on how the loader program can invoke the main title.

Startup Environment

While the system is loading a title into memory, there is a small animation playing on the screen. This animation tells the user that the system is busy and will be done shortly. This animation consumes little memory, and exits the system as soon as the title indicates it is ready to run. Your application can control this animation with a special AmigaCD^{32} library, the freeanim.library. Here are some things to keep in mind for dealing successfully with the startup animation:

- The startup animation runs in an Intuition screen. In order for the exit sequence of the animation to work correctly, titles must not take over the display prior to the animation shutting down.

- The startup animation currently does not use the audio.device but this could change in future versions. It is therefore important for titles to avoid playing any music prior to the animation shutting down unless they first ensure that all channels on the audio.device are available (i.e., not in use).

- When the animation exits the system, it leaves the display completely black. You can assume this in your titles, and fade up from black, or whatever other transitions you wish to do.

Once your title is in memory and wishes to display something on the screen, it needs to do:

```
FreeAnimBase = OpenLibrary("freeanim.library", 0);
```

This will tell the startup animation to begin shutting down, which involves removing itself from the display and freeing the resources it uses. This may take a while, up to about a second. While the startup animation is shutting down, your application can prepare data to display and generally initialize itself. This parallelism reduces the time the user has to wait for the titles to start.

Once you have done what you need to in order to display your title screen, you should do the following:

```
CloseLibrary(FreeAnimBase);
```

This will wait for the animation to complete its shutdown. Once this function has returned, it is now safe to display your title screen. If you have no need to process information while the animation is shutting down, the following will work:

```
CloseLibrary(OpenLibrary("freeanim.library", 0));
```

It is important to note that users may try to run your code on a regular Amiga computer equipped with CD-ROM, i.e. not an AmigaCD^{32}. In that case, there will not be a freeanim.library around, so your code should not fail when freeanim.library cannot be opened. This is easy to do, just don't put any error checking in:

```
FreeAnimBase = OpenLibrary("freeanim.library",0);
/* initialize application stuff */
CloseLibrary(FreeAnimBase);
/* start application animation/display */
```

CloseLibrary() accepts a NULL pointer and ignores it. Therefore if OpenLibrary() fails and returns NULL, CloseLibrary() will still work.

Running Your Titles From Workbench

If Commodore decides to make AmigaCD^{32}-compatible hardware available for its other Amiga computer systems, it would be highly desirable if any existing AmigaCD^{32} titles could be run from Workbench on those systems. This requires only a few lines of code to support:

1. You should handle disc insertion and removal events. On a computer system, it would not be wise to enable the "reboot on removal" feature of cd.device. When running on an AmigaCD^{32}, you should generally reboot when a disc is removed, but in a computer environment, you should deal with this eventuality and handle it gracefully by putting up an error message, or at least quitting the title. Crashing is never a good idea.

2. Your code should handle the Workbench startup environment.

3. Your CD should include icons for the appropriate files.

4. Your code should be able to run without having the startup-sequence from your CD run. This is important. If your program relies on assignments made in the startup-sequence, these will not be present when running from Workbench. An easy solution is to provide an IconX script on the CD that gets run from Workbench and loads in the title. The script can do the needed assigns.

5. Your code should multitask nicely. It should release all its resources on exit. If this is not possible, you must warn the user in the documentation and in the software itself that starting this title will take over the system and cause any unsaved work to be lost.

The startup environment in a computer system will be different from the normal AmigaCD^{32} environment. The freeanim.library will not be there, so your code should not fail if freeanim.library cannot be opened. In addition, there will not be a startup animation in the system, so the initial display will not be a black screen and will instead be the user's Workbench screen.

It would also be a nice touch to make the software runnable when not on the CD. This would allow users to copy the title to their hard drive, enabling potentially much faster operation.

Finally, if you wish your application to look right at home on a CD-ROM-equipped Amiga computer, you should avoid direct references to "AmigaCD^{32}" within your title. The title might actually be running on an A1200 or A4000.

Preferences

CDs should not contain any preferences files. This specifically means that the following files should not be on your CDs:

```
Devs/system-configuration
Prefs/env-archive/sys/#?
```

Including any preferences file can cause odd behavior during the startup animation sequence.

In addition, many CDTV titles used to call the Intuition SetPrefs() function in order to change screen positioning and centering. This is not the correct method and will lead to problems with the startup animation. See the section below on screen positioning for information on how to do it right.

Using System Graphics

There are three basic ways you can set up a display on the Amiga:

- Intuition library OpenScreen()
- Graphics library MakeVPort(), MrgCop(), LoadView()
- Hitting the hardware registers directly

Using Intuition to set up the display is by far the easiest but also has the greatest memory and processing overhead. A reasonable middle course is to set up the display using the lower-level functions provided in the graphics library. In that case, you do not have to coexist peacefully with Intuition (nor do you get any of the nice services it provides). A detailed example showing how to set up your own display with the graphics.library is listed at the end of this chapter.

The worst method of setting up the display is by hitting the hardware registers directly. As the Amiga chip set improves, so many of the internal graphic mechanisms will change that applications using direct access techniques really have no chance of compatibility with future machines.

Graphic Displays

The typical user of the game machine will be using it on the family television set. As such, the display mode that makes the most sense is a low-resolution, 320 x 200 (NTSC) or 256 (PAL), 8-bitplane, 256-color screen. Most games today use the entire display area (i.e., bezel to bezel). To do this on the Amiga requires the use of overscan (more on this in the next section).

The game machine has Chip RAM only, hence, memory is shared between the custom graphics chips and the CPU. Contention between the custom chips and the CPU is an issue to consider. A low-resolution, 8-bitplane display does not involve any cycle stealing from the CPU assuming that the OS has been left in place so that the higher fetch-bandwidth modes of the system are in effect.

Screen Positioning with the OS

With overscan, the Amiga's nominal display dimensions can be extended so that graphics are displayable in what is normally the border area. Prior to Release 2 of the operating system, there was no officially supported way to control overscan displays and only limited support for screen positioning control. Numerous ad hoc techniques of varying quality were invented, and most are still supported, though some only work because of patches designed to keep them operational.

Release 2 (V37) introduced the graphics database and a host of structures to help you control your screen position. For correct operation on the AmigaCD^{32} console, we strongly urge you to use these functions and structures. First, some definitions to help you along:

Text Overscan: this is the old "morerows" size from 1.3, and has been called the "Text Overscan" or "Text Size" in V37+ Overscan Prefs. This rectangle defaults to a nominal-sized rectangle, but can be enlarged and/or repositioned by the user via Overscan Prefs. If this rectangle is correctly set, no pixel in Text Overscan is supposed to be masked by the bezel of the monitor.

Display Clip: a rectangle that describes the desired displayable portion of your screen. The coordinates are in screen-pixels, and the origin is the upper-left corner of the Text Overscan rectangle.

It is best to center your own display with respect to the Text Overscan rectangle. Here's a piece of code to handle it:

```
/* CenterDClip( displayID, width, height, rect )
 * Fills in the struct Rectangle pointed to by rect with a DisplayClip
 * whose size is the width and height specified, and whose position
 * is centered around the Text Overscan rectangle for the specified
 * displayID.
 *
 * Returns TRUE if it succeeds, FALSE if it doesn't (usually caused
 * by an invalid displayID).
 */

BOOL CenterDClip(ULONG displayID, ULONG width, ULONG height,
                 struct Rectangle *rect )
```

```
{
BOOL success = FALSE;
LONG excess_x;
LONG excess_y;

    if ( QueryOverscan( displayID, rect, OSCAN_TEXT ) )
    {
        excess_x = ( width - ( rect->MaxX - rect->MinX + 1 ) );
        excess_y = ( height - ( rect->MaxY - rect->MinY + 1 ) );
        rect->MinX -= excess_x / 2;
        rect->MaxX = rect->MinX + width - 1;
        rect->MinY -= excess_y / 2;
        rect->MaxY = rect->MinY + height - 1;

        success = TRUE;
    }
return( success );
}
```

Sample use:

```
#define MY_DISPLAY_ID  HIRES_KEY
#define MY_WIDTH   whatever
#define MY_HEIGHT  whatever
...

struct Rectangle dclip;

if ( CenterDClip( MY_DISPLAY_ID, MY_WIDTH, MY_HEIGHT, &dclip ) )
{
    if ( myscreen = OpenScreenTags( NULL,
    SA_DClip, &dclip,
    ...
    TAG_DONE ) )
}
```

Centering yourself using CenterDClip() could theoretically give you a Display Clip which extends outside of the OSCAN_MAX Display Clip, which represents the hardware limits. If you would rather be slightly off-center than clipped, you may wish to shift the resulting DClip to fit within Maximum Overscan. The easiest way to get that rectangle is:

```
QueryOverscan( displayID, &maxrect, OSCAN_MAX );
```

New V39 and V40 Graphics Capabilities

The graphics.library for V39 gained many features that make creating system friendly, fast moving graphics and animations much easier. Autodocs for the graphics.library are a good source of information on these new features. Some examples are also available from the 1993 DevCon notes. Of specific interest is the new double-buffering support which is even available in Intuition screens.

V40 of graphics.library which is present in the AmigaCD32 ROM contains a few extra features specifically targeted at improving the performance of animation and rendering code. These features are relatively new and not well known, so they are briefly explained below.

ViewPorts that don't load colors. ViewPorts normally always have a copper list associated with them which loads up all the colors needed for their depth. This new feature makes it so that only color 0 gets loaded within the copper list. For deep screens, this will substantially reduce the copper list length. The rest of the colors are inheritied from the viewport above. This feature is useful to reduce the inter-ViewPort gap, and for faster color cycling. See the VC_NoColorPaletteLoad tag in <graphics/videocontrol.h>andn the graphics.library/VideoControl() Autodoc entry.

Preventing intermediate copper list updating. This speeds up LoadRGB(), SetRGB(), ScrollVPort(), and ChangeVPBitMap(). See the VC_IntermediateCLUpdate tag in <graphics/videocontrol.h>and in the graphics.library/ VideoControl() Autodoc entry.

Dual-playfield disable. Disables setting of the dual playfield bit in dual-playfield ViewPorts. Odd and even bit-planes will still scroll separately, but will be fed directly to the palette. This can be used for instance to do cross-fades between independently scrolling images. See the VC_DUALPF_Disable tag in <graphics/videocontrol.h>and the graphics.library/VideoControl() Autodoc entry.

AmigaCD^{32} includes very fast chunky-to-planar conversion hardware. This allows for high-quality 3D graphics. Consult the documentation for the WriteChunkyPixels() function in the graphics.library Autodoc file for more information. [Note: this function is not yet in the FD or protos but there is a pragma in include/pragmas/graphics_pragmas.h]

Note that the above new ViewPort features work fine in Intuition screens as well. You just need to pass the screen's ViewPort as a parameter to the VideoControl() function.

You might also wish to look at the documentation for the SA_VideoControl and SA_MinimizeISG tags for the OpenScreenTagList() function. These two tags offer Intuition-level control of the new features outlined above. There are also the SA_Interleaved, SA_Exclusive, and SA_Draggable tags which can greatly help writing animation and graphics code. All these tags are documented in <intuition/screens.h>and in the intuition.library Autodoc.

V40 also added many new display modes, four of which are especially useful for animation support. These modes are defined in <graphics/modeid.h>as:

```
/* Added for V40 - may be useful modes for some games or animations. */
#define LORESSDBL_KEY                   0x00000008
#define LORESHAMSDBL_KEY                0x00000808
#define LORESEHBSDBL_KEY                0x00000088
#define HIRESHAMSDBL_KEY                0x00008808
```

These new V40 display modes allow you to display a given raster at twice its normal height. Each line of the raster automatically gets repeated on the screen as it is displayed. This allows a 128 pixel high raster to be displayed as if it were 256 pixels tall. This can be very helpful in order to create full screen animations. For example, a 128 pixel high CDXL animation can suddenly occupy the full screen.

When you use one of these new modes, you *do not* allocate more raster or open a taller screen, i.e., you still allocate a raster of the smaller height (128 for example), and if you are blitting the image you still only blit 128 lines. Doubling the height of your image is a video effect accomplished by the AA hardware. These modes work on a composite monitor or TV.

For more on how to set up a display using graphics.library, see the example at the end of this chapter.

Display Mode Promotion

Mode promotion is a feature which converts 15kHz screens into 31kHz screens, in order to remove interlace flicker, or inter-line gaps. It is the AA equivalent of the A3000 display enhancer hardware.

Mode promotion can be turned on or off by the user. When turned on, screens opened using the 1.3 OpenScreen() function, or opened using a default monitor ID will end up promoted to a 31kHz mode. The promotion process is not totally transparent as certain aspects of the copper list, the refresh rate, and available overscan dimensions are different for the promoted state than for the unpromoted state. These differences can be crucial for many developers.

To avoid promotion affecting your titles, you simply need to open your screens with explicit mode IDs using the PAL_MONITOR_ID and NTSC_MONITOR_ID, instead of using DEFAULT_MONITOR_ID.

Note that promotion is not turned on in AmigaCD^{32} systems, the problem can only surface in a computer environment.

Consult the ROM Kernel manuals, the 1991 and 1993 DevCon notes for more information on display mode IDs and display mode promotion.

Intuition Screen Defaults

Applications that use Intuition to set up their displays need to understand how Intuition defaults work. The default values for the LeftEdge, TopEdge, Width, and Height of a screen can be a bit complex. This is partially due to the fact that they are implicitly specified by supplying a non-NULL NewScreen pointer to OpenScreenTagList(), and by the fact that while Intuition does define STDSCREENWIDTH and STDSCREENHEIGHT magic constants, there are no corresponding constants for standard left-edge and standard top-edge (which are likely non-zero!). The most foolproof strategy is to use a NULL NewScreen structure, using only tags to specify screen attributes, and omit all of SA_Left, SA_Top, SA_Width, and SA_Height. The correct defaults will come from the SA_DClip.

The other way (which is required if using a non-NULL NewScreen), is to supply the correct values for each component (either in the appropriate members of the NewScreen structure or with the appropriate tags). The correct values are:

```
left   =  dclip.MinX
top    =  dclip.MinY
width  =  dclip.MaxX - dclip.MinX + 1
height =  dclip.MaxY - dclip.MinY + 1
```

Note that if your screen is shorter than the nominal height, other screens that are behind you can potentially be visible above your screen.

You are strongly encouraged to use Intuition screens instead of custom Views and ViewPorts. However, if you go that route, you can install a DisplayClip into your ViewPort's ViewPortExtra structure.

Screen Position and Sprites

User preference can shift the Intuition View origin, which in turn can affect the number of sprites available on your screen. If you use sprites other than the pointer sprite, you must take this into consideration, because a change in the upper-left corner of the Text Overscan rectangle shifts the entire coordinate system, so even carefully chosen fixed coordinates may get you into trouble. The upper-left corner of the OSCAN_MAX rectangle is the one which is at a fixed position with respect to the hardware fetch cycle (for a given mode). You can base a positional calculation on this if necessary.

There are some Display Clip positions for which the number of possible sprites varies depending on which fetch mode is used. The higher fetch modes have the advantage of reducing Chip RAM bus saturation, but you may prefer a lower bandwidth with more sprites. Graphics will drop the bandwidth to bring allocated sprites into view if MakeVPort() runs after you obtain your sprites via GetExtSprite(). In an Intuition environment, you should use RemakeDisplay() after you get your sprites (not call MakeVPort() directly).

Avoiding The Workbench Screen

If you use Intuition screens in your titles, it is important to note an Intuition "feature" which can get in the way. Whenever the last screen opened in the system is closed, Intuition automatically opens up the Workbench screen. This can be quite cumbersome in titles which perform transitions between different screens.

Here is a short code sample for SAS/C that defeats this Intuition feature. Simply call CloseScreenQuiet() instead of calling CloseScreen() and all will be fine:

```
ULONG __asm OpenWorkBenchPatch(void)
        {
        return(0);
        }

        VOID CloseScreenQuiet(struct CDUILib *CDUIBase, struct Screen *screen)
        {
        APTR OWB;

        if (screen)
            {
            OWB = SetFunction(IntuitionBase, -0xd2, (APTR)OpenWorkBenchPatch);
            CloseScreen(screen);
            SetFunction(IntuitionBase, -0xd2, OWB);
            }
        }
```

Note that the above code will only work starting with V39 Kickstart. Previous Kickstarts did not support this. AmigaCD^{32} has a V40 Kickstart.

Localization

There are two ways software can be localized on AmigaCD^{32} systems. The lowlevel.library, discussed later in this chapter, offers a very simple mechanism that returns the number of the user's current preferred language. The second method involves using locale.library which provides a complete suite of localization services.

If your title does not use locale.library, it is best to remove the library from your CD. If your title does use locale.library, you must have a directory structure such as:

```
Locale (dir)
Catalogs (dir)
   français (dir)
   westchesterwarrior.catalog
deutsch (dir)
   westchesterwarrior.catalog
italiano (dir)
   westchesterwarrior.catalog
Languages (dir)
   français.language
   italiano.language
   deutsch.language
```

That is, you need a Locale directory which contains a Catalogs and a Languages subdirectory. There is no need to include the Countries directory that comes with the Workbench disk, this directory is only of use to the Locale preferences editor.

The Catalogs directory must contain one subdirectory for each language that your title supports. Within these directories, you can put the standard locale.library catalogs files (see locale.doc and catcomp.doc for more information).

The Languages directory must contain a language driver for each of the languages your title supports. These language drivers are supplied with Workbench 3.1 on the Locale disk. The LOCALE: assignment must exist if you use locale.library. It should be made to the Locale directory described above.

New Amiga CD^{32} System Software

Five special system modules were created for the AmigaCD^{32} console:

- lowlevel.library
- nonvolatile.library
- freeanim.library
- cd.device
- CD-ROM file system

You can use these modules with full confidence that they will be upwardly compatible with future systems from Commodore. The lowlevel.library, nonvolatile.library and the CD-ROM file system will be part of Workbench 3.1 and will be shipped within the 3.1 Enhancer kits and with new machines that include Workbench 3.1. The freeanim.library will not be included with the normal Workbench distribution, but your code does not need to rely on its presence (see below for more on this). Finally, cd.device will be included with any AmigaCD^{32}-compatible solutions that Commodore will offer for its computer systems in future.

The nonvolatile.library

The purpose of this library is to allow an application to save small amounts of information to nonvolatile memory or a disk device without having to burden the application with determining which device to use. It provides a simple, common access method to whichever device the user chooses. This library also provides access to true nonvolatile memory present on the game machine. See the nonvolatile.library Autodocs in Chapter 4 for more information on this library.

The lowlevel.library

The lowlevel.library provides many functions useful for game developers. Among other things, this library provides the only means to read the AmigaCD^{32} game controller.

Aside from the game controller code, the main purpose for lowlevel.library is to provide functions that are often needed by game developers. Most of the functions in this library should not be used in the Amiga's normal multitasking environment--instead they are appropriate for high-performance games which require the takeover of the system. Aside from the game controller code, everything else in lowlevel.library can be done better--in a way that supports multitasking--using other system modules, though more work may be involved. The next section shows how to solve some common programming problems using the lowlevel.library.

Game Programming Problems and Solutions

Speed of graphics rendering is the reason programmers usually cite for taking over the system. This is not a very good reason. In this section, some alternatives are described that you should consider instead of directly programming the hardware registers.

Blitter

If you have your own blitter routines that are faster than the routines in ROM, you can use them in a way that is friendly to the operating system. Use OwnBlitter() and DisownBlitter() to claim and relinquish ownership of the blitter registers.

First call OwnBlitter(), do any required setup, call WaitBlit(), poke the blitter registers, and then DisownBlitter() when all blits are done. This is a very low-overhead way to use direct hardware access; OwnBlitter() is only 3 instructions (counting RTS) when no one else is trying to use the blitter. You must use the graphics.library WaitBlit(). This is as fast as possible, uses no CPU registers, and knows about blitter bugs. You cannot possibly write one that is more efficient and works on all Amigas.

For asynchronous blits, use the QBlit() and QBSBlit() functions. These have been rewritten for the 3.0 version of the operating system and now have quite low overhead. These let you use the blitter in an interrupt driven manner instead of polling for completion.

Copper

If you want to do full-screen animation, it is not necessary to take over the system at boot time or directly control the Copper registers. Instead, use a user-Copper list to cause a Copper interrupt on line 0 of your ViewPort.

The copper interrupt handler you install can signal a high-priority task that calls ChangeVPBitMap() (or ScrollVPort()) and LoadRGB32() to change both bitmap pointers and colors in sync. This allows for perfect 60 Hz animation even while moving the mouse as fast as possible and inserting floppy disks.

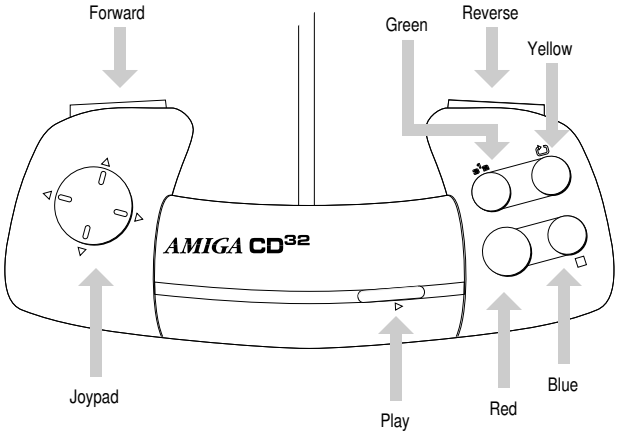
Under 3.0, you can also do this in an Intuition SA_Exclusive screen. You can tell if it was your screen which caused the copper interrupt by checking to see if the flag VP_HIDE is clear in your ViewPort->Modes.

If you really have to take over the Copper, first call LoadView(NULL), do two WaitTOF()s, and then install your own copper lists in the cop1/2jmp registers. We do not recommend this though. Future chipsets will have faster and more efficient coppers with different registers. If you load copper registers directly, your code will break on these future systems.

```
temp=GfxBase->ActiView;
LoadView(NULL);
WaitTOF();
WaitTOF(); /* custom.cop1lc = ??? */
...
WaitTOF();
WaitTOF();
LoadView(temp);
custom.cop1lc=GfxBase->copinit;
```

Getting User Input

On the game machine, input will usually come from the "game controller." This is a hand-held controller similar to the type used on CDTV and the Nintendo SNES. It plugs into the standard, 9-pin D connectors on the side of the system. It has six action buttons, one start button and four directional arrows. Input could also come from a mouse or joystick.



All three types of game controllers can be conveniently managed with the ReadJoyPort() function in the lowlevel.library. This function is the only way to get Amiga CD^{32} game controller information. One drawback of this function is that it requires a polling loop. So applications designed to run in the Amiga's multitasking environment may want to use other methods to get joystick and mouse information. The mouse and joystick information can be obtained from Intuition, from the gameport.device, or from the hardware port registers directly.

Before looking at the hardware registers directly, it is imperative that you allocate the associated hardware resources using the GPD_ASKCTYPE and GPD_SETCTYPE commands of the gameport.device. You should also allocate the POTGO resource bits to acquire buttons 2 and 3. Code that demonstrates how to do this is listed on pages 89, 94-95 and 344 of the *Amiga ROM Kernel Reference Manual: Devices*, 3rd edition (ISBN 0-201-56775-X).

```
            move.l  _AbsExecBase,a6
            lea     lowllib(pc),a1        ; Open low-level library
            move.l  #0,d0                 ;  version 0
            jsr     _LVOOpenLibrary(a6)
            tst.l   d0                    ; Make sure it opened
            beq.w   exit1
            move.l  d0,a5                 ; Save LowLevelBase in A5

            moveq.l #1,d0                 ;Read status of game connector #1
            jsr     _LVOReadJoyPort(a6)   ; with the ReadJoyPort() function.
            move.l  d0,d2                 ; Save joy 1 status in d2

            andi.l  #JP_TYPE_MASK,d0      ;Get the controller type in d0
            cmpi.l  #JP_TYPE_MOUSE,d0     ; Is it a mouse?
            bne.s   notmouse

            ;It's a mouse.
notmouse
            cmpi.l  #JP_TYPE_JOYSTK,d0    ;It's not a mouse, so...
            bne.s   notjoy                ; Is it a joystick?

            ;It's a joystick
```

```
notjoy                                  ;It's not a mouse or joystick, so...
            cmpi.l  #JP_TYPE_GAMECTLR,d0 ; Is it an AmigaCD32 game controller?
            bne.s   default

            ;It's an AmigaCD32 game controller
default
            ;It's type is unknown or not available

            move.l  _AbsExecBase,a6      ;Close Low-level Library
            move.l  a5,a1
            jsr     _LVOCloseLibrary(a6)
exit1
            rts
lowllib     dc.b    'lowlevel.library',0
            end
```

The fragment above shows how to use the ReadJoyPort() function of lowlevel.library. The same fragnent is shown below in C language.

```
#define PORTNO 1L             /* Controller connector to read */
struct Library *LowLevelBase;  /* Global, define above main()  */
...

ULONG status;
GameBase=OpenLibrary("lowlevel.library",  0L );
if(GameBase)
    {
    /* Do set up, then, in main loop... */
    status = ReadJoyPort( PORTNO );
    switch( status & JP_TYPE_MASK )
        {
        case JP_TYPE_GAMECTLR: /* It's a game controller */
            break;
        case JP_TYPE_MOUSE:    /* It's a mouse */
            break;
        case JP_TYPE_JOYSTK:   /* It's a joystick */
            break;
        default:               /* Contoller type unknown or unavailable */
        }
    CloseLibrary(LowLevelBase);
    }
```

Dealing with the Input Device

On the Amiga, the input.device is the system module that processes input events such as mouse movement and keystrokes passing them on to Intuition and other interested clients. If the system is not being completely shut down by use of the SCON_TakeOverSys tag to SystemControlA() the system overhead can be reduced by shutting down input.device. Obviously this should not be done if your application depends on input.device for gathering input.

There are two ways to do this. With lowlevel.library, the SystemControl() function can be used with the SCON_StopInput tag set to TRUE. This stops the input.device from using any CPU time and also prevents it from passing along input events to Intuition. This is the easiest way to shut down the input.device on the CD game machine.

A solution which is more multitasking-friendly is to install a high priority input handler which chokes off all events. To do this, you use the IND_ADDHANDLER and IND_REMHANDLER commands of

the input.device. Examples of how to use these are listed on pages 108 and 109 of the *Amiga ROM Kernel Reference Manual: Devices*, 3rd edition (ISBN 0-201-56775-X). By using a priority of 51, you can make your input handler first in the chain and prevent other handlers (like Intuition) from seeing input activity. This handler is also a convenient way to get keys and mouse events yourself. Simply store the raw keypresses and mouse moves in your own variables.

The CD game machine in its base configuration does not include a keyboard. However, a keyboard is planned as part of an expansion option for the system. Programs that want to support this option can get keyboard events in a variety of ways. The lowlevel.library functions AddKBInt() and RemKBInt() will add and remove code you provide to the system's keyboard interrupt servicing allowing you to detect raw keypresses.

If you prefer to poll the keyboard as part of your main processing loop, use the lowlevel.library function GetKey(). This returns a raw key value for the current key pressed and also any qualifier keys (such as Shift) that are pressed at the same time. To monitor the state of a given set of keys, you can use the lowlevel.library function QueryKeys(). You pass this function an array of raw key codes for the keys you want to know about and it returns their current state.

Another alternative that is multitasking friendly is to obtain input from the keyboard.device. This has the advantage of dealing with all the various keyboard timings, but it is easier by far to open an Intuition window and read either RAWKEY or VANILLAKEY IDCMP messages. These either give the raw key number pressed, or the character the key pressed represents (useful for international games).

Timing

For calculating elapsed time, there are a variety of possible solutions. For a variable-speed, high-precision, interrupt-driven time source, programs can use the timer functions of the lowlevel.library. These functions provide a way for your code to be called continuously at arbitrary intervals. For instance the example below shows how to wait for precisely 1000 microseconds.

```
struct Library *LowLevelBase;

struct TIData                                   /* This is just a structure  */
    {struct Task *atask;                        /* to hold parameters passed */
     LONG         asignal;                      /* to the interrupt routine. */
    };

VOID __asm __interrupt __saveds                 /* Here's the timer interrupt */
TIRoutine (register __a1 struct TIData *tidata) /* routine. It simply signals */
{                                               /* the parent task pointed to */
Signal( tidata->atask, 1L << tidata->asignal ); /* by register A1.            */
}

VOID
main ( int argc, char **argv)
{
APTR          ti_handle;                        /* lowlevel.library timer handle  */
struct TIData ti_data;                          /* Pointer to interrupt arg.s */

LowLevelBase = OpenLibrary ( "lowlevel.library", 0L);
if(LowLevelBase)
    {
    ti_data.atask = FindTask( NULL );           /* Fill in TIData structure   */
    ti_data.asignal = AllocSignal(-1L);         /* so interrupt routine can   */
    if(ti_data.asignal!=-1)                     /* signal us.                 */
```

```
        {
        /* Attach the TIRoutine to the timer generated interrupt. */
        ti_handle = AddTimerInt(TIRoutine, &ti_data);
        if(ti_handle)
            {
            /* Start the timer; TIRoutine will be called every 1000 microsecs */
            StartTimerInt(ti_handle, 1000L , TRUE );

            Wait(1L << ti_data.asignal);        /* Wait for interrupt signal. */

            StopTimerInt(ti_handle);            /* Tidy up.  Free any system  */
            RemTimerInt(ti_handle);             /* resources used.            */
            }
        FreeSignal(ti_data.asignal);
        }
    CloseLibrary(LowLevelBase);
    }
}
```

Here is a similar example in 68020 assembly language. This time, the example flashes the display every 1024 ticks for a total delay of just over 10 seconds.

```
                STRUCTURE TIData,0
                    LONG asignal
                    APTR atask
                LABEL TIData_sizeof
;
        move.l  _AbsExecBase,a6
        lea.l   lowllib(pc),a1          ; Open low-level library
        move.l  #0,d0                   ;  version 0
        jsr     _LVOOpenLibrary(a6)
        tst.l   d0                      ; Make sure it opened
        beq.w   exit3
        move.l  d0,LowLevelBase         ; Save the base so we can close later

        lea.l   intulib(pc),a1          ; Open Intuition Library
        move.l  #0,d0                   ;  version 0
        jsr     _LVOOpenLibrary(a6)
        tst.l   d0                      ; Make sure it opened
        beq.w   exit2
        move.l  d0,IntuitionBase        ; Save the base so we can close later

        move.l  #0,a1                   ;Call Exec FindTask(NULL);
        jsr     _LVOFindTask(a6)        ; to get a pointer to the process.
        lea.l   ti_data(pc),a0
        move.l  d0,atask(a0)            ;

        move.l  #-1,d0                  ;Allocate a signal with Exec
        jsr     _LVOAllocSignal(a6)     ; AllocSignal(-1L)
        cmpi.l  #-1,d0
        beq.w   exit1
        lea.l   ti_data(pc),a0          ;Store the allocated signal number
        move.l  d0,asignal(a0)          ; in the asignal field of ti_data

        move.l  LowLevelBase(pc),a6     ;Add in the timer interrupt
        lea.l   TIRoutine(pc),a0
        lea.l   ti_data(pc),a1
        jsr     _LVOAddTimerInt(a6)
        tst.l   d0
        beq.w   exit0
        move.l  d0,ti_handle

        move.l  d0,a1                   ;Start the timer
        move.l  #1000,d0
        move.l  #TRUE,d1
        jsr     _LVOStartTimerInt(a6)

        move.l  #10*1024,d4             ;Register d4 is the loop counter
```

```
mainloop
        move.l  _AbsExecBase,a6
        lea.l   ti_data(pc),a0
        move.l  asignal(a0),d1
        move.l  #1,d0
        asl.l   d1,d0
        jsr     _LVOWait(a6)

        move.l  d4,d0
        andi.l  #$000003ff,d0           ;Flash the screen every 1024 ticks
        bne.s   looptest

        move.l  IntuitionBase(pc),a6
        move.l  #0,a0
        jsr     _LVODisplayBeep(a6)

looptest
        subi.l  #1,d4
        tst.l   d4
        bne.w   mainloop

        move.l  LowLevelBase(pc),a6
        lea.l   ti_handle(pc),a1
        jsr     _LVOStopTimerInt(a6)

        move.l  ti_handle(pc),a1
        jsr     _LVORemTimerInt(a6)
exit0
        move.l  _AbsExecBase,a6         ;Free the signal stored in the asignal
        lea.l   ti_data(pc),a1          ;field of ti_data
        move.l  asignal(a1),d0
        jsr     _LVOFreeSignal(a6)
exit1
        move.l  IntuitionBase(pc),a1    ;Close Intuition library
        jsr     _LVOCloseLibrary(a6)
exit2
        move.l  LowLevelBase(pc),a1     ;Close low-level library
        jsr     _LVOCloseLibrary(a6)
exit3
        rts

TIRoutine
        move.l  _AbsExecBase,a6         ;Prepare to call Exec Signal()
        move.l  asignal(a1),d1          ; register d0 contains the
        move.l  #1,d0                   ; signal mask created from asignal
        asl.l   d1,d0                   ;
        move.l  atask(a1),a1            ; register a1 points to the task
        jsr     _LVOSignal(a6)
        rts

;============== Data Area
LowLevelBase    dc.l    0
IntuitionBase   dc.l    0
loopcount       dc.l    0
ti_handle       dc.l    0
ti_data         ds.b    TIData_sizeof,0
                cnop 2
lowllib         dc.b    'lowlevel.library',0
                cnop 2
intulib         dc.b    'intuition.library',0
        end
```

The lowlevel.library timer functions use the CIA chips (or equivalents) as the source for timing information. On systems prior to V40 that have no lowlevel.library, you will have to use the CIA timing facilities at a lower level. This involves a lot more housekeeping on the part of your application. For example code demonstrating how to do this, refer to pages 328-335 of the *Amiga ROM Kernel Reference Manual: Devices*, 3rd edition (ISBN 0-201-56775-X).

Another timing source is available through the timer.device called the E-Clock. The E-Clock is the clock used by the Motorola 680x0-family of processors to communicate with Motorola 8-bit devices. ReadEClock() is a timer.device function that provides a simple, low overhead way to determine

elapsed E-Clock time. It returns two values: a 64-bit timer value (the E-Clock count) and a 32-bit frequency value in ticks/second (the E-Clock frequency, related to the master frequency of the machine and different between PAL and NTSC systems). Usage of the E-Clock is shown on page 298 of the *Amiga ROM Kernel Reference Manual: Devices*, 3rd edition, (ISBN 0-201-56775-X). There is also a convenient interface to the EClock provided by the lowlevel.library function ElapsedTime(). See the Autodocs in Chapter 4 for more information.

For timings that require less granularity, the system vertical blank can be used as a special low-frequency timer. WaitTOF() will suspend your task until the top of frame is reached (and all vertical blank interrupt servers have been called). The frame rate depends on whether the system is running in a PAL or NTSC environment but is totally independent of the processor speed:

```
ULONG frate;
frate = (GfxBase->DisplayFlags & PAL) ? 50 : 60;
for( i=0; i < frate; i++ )
    WaitTOF();
```

As a convenience, V40 of the operating system includes a new field in GfxBase named VBCounter. The VBCounter field is a longword which is incremented by the system every vertical blank.

Audio

The audio device is one of the simplest, lowest overhead modules in the system. In general, there is no reason to hit the hardware directly. There are device commands to change the volume, period, frequency and data that is played on any of the four channels.

Some applications may want to modulate one voice with another or exceed the 28,000 byte/second sample playback rate by using CPU-driven audio instead of DMA-driven audio. In that case, direct

```
VOID           main( int argc, char **argv)
{
struct IOAudio *myAIOreq=NULL;
struct MsgPort *myAIOreply=NULL;
UBYTE chans[] = {15};             /* Allocate all 4 audio channels */
BYTE dev = -1;

myAIOreq=(struct IOAudio *)AllocMem(sizeof(struct IOAudio),MEMF_PUBLIC );
if(myAIOreq)
    {
    myAIOreply=CreatePort(0,0);
    if(myAIOreply)
        {
        myAIOreq->ioa_Request.io_Message.mn_ReplyPort    = myAIOreply;
        myAIOreq->ioa_Request.io_Message.mn_Node.ln_Pri  = 127;
        myAIOreq->ioa_Request.io_Command                 = ADCMD_ALLOCATE;
        myAIOreq->ioa_AllocKey                           = 0;
        myAIOreq->ioa_Data                               = chans;
        myAIOreq->ioa_Length                             = sizeof(chans);

        dev=OpenDevice("audio.device",0L,(struct IORequest *)myAIOreq,0L);
        if(! dev)
            {
            /* Your code that uses audio hardware registers goes here */

            CloseDevice(myAIOreq);
            }
        else { /* Couldn't get all 4 channels. */ }
        DeletePort( myAIOreply );
        }
    FreeMem( myAIOreq, sizeof(struct IOAudio) );
    }
}
```

```
;Imports (amiga.lib) ====================
            xref   _CreatePort
            xref   _DeletePort
;Exports=================================
            xdef   _SysBase
;Equates=================================
_SysBase    EQU   4
SIZEOFCHANS EQU   1                         ;Number of bytes in chans, the
                                            ; channel allocation array

            move.l  _SysBase,a6             ;Allocate memory for the IOAudio
            move.l  #ioa_SIZEOF,d0
            move.l  #MEMF_PUBLIC,d1
            jsr     _LVOAllocMem(a6)
            move.l  d0,a3                   ;a3 = a pointer to my IOAudio
            tst.l   d0                      ;     request block
            beq     exit3

            move.l  #0,-(sp)                ;Call the amiga.lib C function
            move.l  #0,-(sp)                ; CreatePort() to create a
            jsr     _CreatePort             ; reply port
            addq.l  #8,sp
            move.l  d0,a4                   ;a4 = a pointer to my IOAudio
            tst.l   d0                      ;     reply message port
            beq     exit2
                                            ;Initialize the IOAudio request
                                            ;myAIOreq
            move.w  #0,ioa_AllocKey(a3)             ; ->ioa_AllocKey
            lea.l   chans(pc),a1                    ;
            move.l  a1,ioa_Data(a3)                 ; ->ioa_Data
            move.l  #SIZEOFCHANS,ioa_Length(a3)     ; ->ioa_Length
            move.w  #ADCMD_ALLOCATE,IO_COMMAND(a3)  ; ->ioa_Request.io_Command
            move.l  a4,MN_REPLYPORT(a3)             ; ->ioa_Request.io_Message.
                                                    ;     mn_ReplyPort
            move.b  #127,LN_PRI(a3)                 ; ->ioa_Request.io_Message.
                                                    ;     mn_Node.ln_Pri
            lea.l   adname(pc),a0
            moveq.l #0,d0                   ;OK now call open device, unit 0,
            move.l  a3,a1                   ; on the audio.device
            moveq.l #0,d1
            jsr     _LVOOpenDevice(a6)
            tst.l   d0                      ; Make sure it opened
            bne.w   exit1

            move.l  #SIGBREAKF_CTRL_C,d0    ;Wait() for Ctrl-C
            jsr     _LVOWait(a6)

            move.l  a3,a1                   ;Call CloseDevice() to free
            jsr     _LVOCloseDevice(a6)     ;  channels
exit1
            move.l  a4,-(sp)                ;Delete reply port
            jsr     _DeletePort
            addq.l  #4,sp
exit2
            move.l  a3,a1                   ;Free the IOAudio memory
            move.l  #ioa_SIZEOF,d0
            jsr     _LVOFreeMem(a6)
exit3
            rts

; Data Area ========================
chans       dc.b    15
            cnop    2
adname      dc.b    'audio.device',0
            end
```

hardware access is required. If you must hit the audio hardware, you can ask for the channel you need with the highest priority (127). The code above shows how:

The audio channels will never be stolen from you, nor will they be used by anyone else until you give the channels back to the system.

Generating Random Numbers

In all games you will need at least some element of randomness in the game to prevent the user from feeling bored during repeat plays. There are a variety of ways to generate random numbers.

The code below is based on the random-number routine from Semi-Numerical Algorithms: The Art of Computer Programming, Vol. 2, by Donald Knuth. The function rand_word() will return a random 16-bit value and has an extremely long period. The rand_word() function uses a table for speed; the table is initialized with another random number generator (which is slightly slower because it has a multiply in it).

```
init_table:
; initialize random # generator - pass d0 = a random seed (based off of time)
; trashes d0/d1,a0
        moveq   #54,d1
        lea     rand_table(a6),a0
1$:     move    d0,(a0)+
        mulu    #$1efd,d0
        add     #$dff,d0
        dbra    d1,1$
        move.l  a0,(a0)
        move.l  #rand_table+24*2,j_index(a6)
        rts

rand_word:
; return a random word in d0
; trashes a0/a1
        lea     rand_table(a6),a1
        move.l  j_index(a6),a0
        move.w  -(a0),d0
        cmp.l   a0,a1
        bne.s   2$
        lea     rand_table+55*2(a6),a0
2$:     move.l  a0,j_index(a6)
        move.l  k_index(a6),a0
        add     -(a0),d0
        move    d0,(a0)
        cmp.l   a0,a1
        bne.s   3$
        lea     rand_table+55*2(a6),a0
3$:     move.l  a0,k_index(a6)
        rts

        section variables

;!! rand_table must precede k_index
rand_table      ds.w    55
k_index dc.l    0
;!! k_index must follow rand_table

j_index dc.l    0

        end
```

You will want to use a different seed value each time your program is run. The best way to do this is by using the ReadEClock() routine of the timer device to obtain a seed value. The EClock is a high speed, free-running, 64-bit timer that increments every 279.5 ns. This is fast enough so that now matter how the the program is started, you are very likely to get a different reading from the EClock from one game to the next. (See the earlier section on Timing for more information.)

An alternative to the table-driven random number generator above is listed in the Random() and RandomSeed() assembly-language functions below. These functions are callable from either C or

assembly language. The amiga.lib link library provided by Commodore has additional random number routines FastRand() and RangeRand() that can be called only from a C-language program. Here's a C program that demonstrates how to call these functions to obtain a random number.

```
;/* test_random.c - Execute me to compile me with SAS C 5.10
LC -b1 -cfist -v -j73 test_random.c
Blink FROM LIB:c.o,test_random.o,random.o TO test_random LIBRARY
LIB:LC.lib,LIB:Amiga.lib
quit

* Shows the use of both the Amiga.lib RangeRand() function and the
* random.asm Random() function it is linked with to demonstrate
* two ways for generating random numbers.
*
* Uses Intuition CurrentTime() to get a seed for the random number generator
* Alternately, you could use the 2.0 timer.device function ReadEClock
*/

#include <exec/types.h>
#include <exec/memory.h>
#include <dos/dos.h>
#include <intuition/intuition.h>

#include <clib/exec_protos.h>
#include <clib/dos_protos.h>
#include <clib/intuition_protos.h>
#include <clib/graphics_protos.h>

#include <stdlib.h>
#include <stdio.h>
#include <string.h>

#ifdef LATTICE
int CXBRK(void)  { return(0); }  /* Disable Lattice CTRL/C handling */
void chkabort(void) { return; }  /* really */
#endif


#define MINARGS 1

UBYTE *vers = "\0$VER: test_random 39.1";

/* Option 1: Random.asm  RandomSeed() and Random() and functions
 *
 * RandomSeed() - Seed with a variable number such as the current time
 *
 * Random() - Pass limit of 0-65535, returns a number between 0 and (limit-1)
 */
extern void RandomSeed(ULONG seedvalue);
extern int  Random(LONG limit);

/* Option 2:
 * Amiga.lib ULONG RangeSeed and RangeRand() function
 *
 * RangeRand() - Pass limit of 0-65535, returns a number between 0 and (limit-1)
 */
#include <clib/alib_protos.h>
extern ULONG far RangeSeed;


void testrand(LONG limit);

struct Library *IntuitionBase;

void main(int argc, char **argv)
    {
    ULONG secs,mics,seed;

    if(IntuitionBase = OpenLibrary("intuition.library",0))
        {
        /* We'll use CurrentTime() to get an initial "seed" value.
         * You could also use the 2.0 timer.device function ReadEClock.
         * If you use the same seed value, you'll get the same
         * sequence of "random" values each time you run the program.
         */
```

```
        CurrentTime(&secs,&mics);  /* Use as our seed */
        seed = secs + mics;
        printf("secs=%ld mics=%ld, seed = $08lx\n",secs, mics, seed);

        /* We'll be testing both the random.asm Random() function and the
         * amiga.lib RangeRand() function so we need to seed each with a
         * starter random value by using the seed method each requires
         *
         */
        RandomSeed(seed);          /* seed random.asm Random()   */
        RangeSeed = seed;          /* seed Amiga.lib RangeRand() */

        /* Call both functions to get some random numbers, passing limit
         * Both functions return random numbers from 0 through limit-1
         * Note however that 0 cannot be passed as limit to RangeRand()
         */
        testrand(3);
        testrand(11);
        testrand(512);
        testrand(65535);

        CloseLibrary(IntuitionBase);
        }
    }


void testrand(LONG limit)
    {
    int k, ktries;

    ktries = 10;

    /* Note: Can pass limit 0-65535, returns number from 0 to limit-1 */
    printf("Random(): %ld random values between 0 and %ld:\n",ktries,limit-1);
    for(k=0; k<ktries; k++)   printf("%ld ",Random(limit));
    printf("\n");

    /* Note: Can pass limit 1-65535, returns number from 0 to limit-1  */
    printf("RangeRand(): %ld random values between 0 and %ld:\n",ktries,limit-1);
    for(k=0; k<ktries; k++)   printf("%ld ",RangeRand(limit));
    printf("\n\n");
    }
```

```
* Random number generator

                XDEF     RandomSeed,Random      assembler entry points
                XDEF    _RandomSeed,_Random     C entry points
                CODE
;===========================================================================
; NAME
;    RandomSeed - seed random number generator, call once at beginning of
;                 your program.  CurrentTime provides useful values for this
;
; SYSNOPSIS
;    RandomSeed( SeedValue )
;                   D0
;
; FUNCTION
;    Seeds the random number generator
;
; INPUTS
;    SeedValue - a longword containing any value you like
;
; RESULT
;    Random number generator is initialised
;
; BUGS/LIMITATIONS
;    None that I know of
;
;===========================================================================
```

```
_RandomSeed     MOVE.L  4(SP),D0        entry point for C functions
RandomSeed      ADD.L   D0,D1           user seed in d0 (d1 too)
                MOVEM.L D0/D1,RND

; drops through to the main random function (not user callable)

LongRnd         MOVEM.L D2-D3,-(SP)
                MOVEM.L RND,D0/D1       D0=LSB's, D1=MSB's of random number
                ANDI.B  #$0E,D0         ensure upper 59 bits are an...
                ORI.B   #$20,D0         ...odd binary number
                MOVE.L  D0,D2
                MOVE.L  D1,D3
                ADD.L   D2,D2           accounts for 1 of 17 left shifts
                ADDX.L  D3,D3           [D2/D3] = RND*2
                ADD.L   D2,D0
                ADDX.L  D3,D1           [D0/D1] = RND*3
                SWAP    D3              shift [D2/D3] additional 16 times
                SWAP    D2
                MOVE.W  D2,D3
                CLR.W   D2
                ADD.L   D2,D0           add to [D0/D1]
                ADDX.L  D3,D1
                MOVEM.L D0/D1,RND       save for next time through
                MOVE.L  D1,D0           most random part to D0
                MOVEM.L (SP)+,D2-D3
                RTS

;===========================================================================
; NAME
;    Random - returns a random integer in the specified range
;
; SYSNOPSIS
;    RndNum = Random( UpperLimit )
;      D0                 D0
;
; FUNCTION
;    returns a random integer in the range 0 to UpperLimit-1
;
; INPUTS
;     UpperLimit - a long(or short will do) in the range 1-65535
;
; RESULT
;    a random integer is returned to you, real quick!
;
; BUGS/LIMITATIONS
;    range was limited to 0-65535 to avoid problems with the DIVU instruction
;    which can return real wierd values if the result is larger than 16 bits.
;
;===========================================================================

_Random         MOVE.L  4(SP),D0        C entry point
Random          MOVE.W  D2,-(SP)
                MOVE.W  D0,D2           save upper limit
                BEQ.S   10$             range of 0 returns 0 always
                BSR.S   LongRnd         get a longword random number
                CLR.W   D0              use upper word (it's most random)
                SWAP    D0
                DIVU.W  D2,D0           divide by range...
                CLR.W   D0              ...and use remainder for the value
                SWAP    D0              result in D0.W
10$             MOVE.W  (SP)+,D2
                RTS

                BSS
RND             DS.L    2               random number
                END
```

CD Drive Issues

The unit name for the CD-ROM drive on the game machine is CD0:. This is the same name used on CDTV and on the A570 CD-ROM peripheral for the A500. However keep in mind that other vendors who provide CD-ROM drives for the Amiga may use a different drive name. For future compatibility try to use paths relative to your application's volume name rather than relative to the unit name. The system also provides a special process-relative assign named PROGDIR:. This assignment exists for every process except those on the resident list and will be the directory from which the process's executable was loaded.

Another drive consideration is that titles that could run on an A4000 or A1200 equipped with a CD-ROM drive will not be able to boot from CD on such systems (no ISO filesystem in ROM in V39 and earlier). This is one excellent reason to enable your product to run from the Workbench.

Similarly, products that use the CD-ROM at the lowest level, i.e., by making calls to cd.device, are unlikely to work with CD-ROM drives from other vendors whose implementations of the ISO filesystem is different. To avoid this compatibility pitfall, stick to the higher-level filesystem interface to the CD drive. Just use the dos.library.

Memory

The CD game machine will have two megabytes of Chip RAM in its base configuration. There are a fairly large number of wait-states when accessing Chip RAM. ROM is zero wait-states. Due to the slow RAM speed, it may be better to use calculations for some things that you might have used tables for on the A500. Add-on RAM (Fast RAM) will probably be faster than Chip RAM, so it is worth segmenting your game so that parts of it can go into Fast RAM if available.

CPU Speed Issues

With the 68EC020 processor used in all CD game machines, there are some special coding techniques you can use to improve performance. For example, it is critical that you code any important loops to execute entirely from the on-chip 256-byte cache. A straight line loop 258 bytes long will execute far slower than a 254 byte one. The '020 is a 32-bit chip. Longword accesses will be twice as fast when they are aligned on a longword boundary. Aligning the entry points of routines on 32-bit boundaries can help, also. You should also make sure that the stack is always longword aligned. Write accesses to Chip RAM incur wait-states. However, other processor instructions can execute while results are being written to memory:

```
move.l  d0,(a0)+   ; store x coordinate
move.l  d1,(a0)+   ; store y coordinate
add.l   d2,d0          ; x+=deltax
add.l   d3,d1          ; y+=deltay
```

will be slower than:

```
move.l  d0,(a0)+   ; store x coordinate
add.l   d2,d0          ; x+=deltax
move.l  d1,(a0)+   ; store y coordinate
add.l   d3,d1          ; y+=deltay
```

The 68020 adds a number of enhancements to the 68000 architecture, including new addressing modes and instructions. Some of these are unconditional speedups, while others only sometimes help.

New Addressing Modes

Scaled Indexing. The 68000 addressing mode (disp,An,Dn) can have a scale factor of 2, 4 or 8 applied to the data register on the 68020. This is totally free in terms of instruction length and execution time. For example:

```
68000                   68020
add.w   d0,d0           move.w  (0,a1,d0.w*2),d1
move.w  (0,a1,d0.w),d1
```

16-bit Offsets on An+Rn Modes. The 68000 only supported 8-bit displacements when using the sum of an address register and another register as a memory address. The 68020 supports 16-bit displacements. This costs one extra cycle when the instruction is not in cache, but is free if the instruction is in cache. 32-bit displacements can also be used, but they cost 4 additional clock cycles.

Data Registers Used as Addresses. Register (d0) is 3 cycles slower than (a0), and it only takes 2 cycles to move a data register to an address register, but this can help in situations where there is no free address register.

Memory Indirect Addressing. These instructions can help in some circumstances when there are not any free registers to load a pointer into. Otherwise, they lose.

New Instructions

Extended Precision Divide and Multiply. The 68EC020 can perform 32x32->32,32x32->64 multiplication and 32/32 and 64/32 division. These are significantly faster than the multi-precision operations which are required on the 68000.

EXTB. The sign extend byte to longword instruction is faster than the equivalent EXT.W EXT.L sequence on the 68000.

CMPI and TST. Compare immediate and TST work in program-counter relative mode on the 68020.

Shift Instructions. On the '020, all shift instructions execute in the same amount of time, regardless of how many bits are shifted. Note that ASL and ASR are slower than LSL and LSR. The break-even point on ADD Dn,Dn versus LSL is at two shifts.

Bit Field Instructions. BFINS inserts a bitfield, and is faster than 2 MOVEs plus an AND and an OR. This instruction can be used nicely in fill routines or text plotting. BFEXTU/BFEXTS can extract and optionally sign-extend a bitfield on an arbitrary boundary. BFFFO can find the highest order bit set in a field. BFSET, BFCHG, and BFCLR can set, complement, or clear up to 32 bits at arbitrary boundaries.

General Do's and Don'ts

- Do clear unused bits when writing, and mask out unused or unneeded bits when reading.
- Don't use timing loops. The reasons should be obvious.
- Don't write self-modifying code unless you know how instruction caches work.
- If you are hardware banging, don't assume anything about the initial contents of the display registers (or any other registers) when your program is started. Initialize everything.
- If using ViewPorts, be sure to have a properly allocated ViewPortExtra. Some graphics calls are faster when one is present.
- Do note well the warning around the copinit structure.

Conclusion

Writing OS-friendly games benefits you, the developer, and the gamers who buy your games. It ensures the viability of your code on all Amiga platforms, not just the one you used for development. By allowing the OS to do the mundane details of opening screens and windows, you give yourself more time to do the creative portions of your game. It does not matter how fast your game is if the gameplay is lousy and the artwork looks amateurish.

An OS-friendly game is no longer something to be avoided. We've provided ample tools in the OS to support your gaming needs, and we will continue to do so. To get you started, the examples on the folowing pages show you how to set up your own View and ViewPort in both C and assembly language. The sooner you write OS-friendly games, the sooner you'll be prepared for the future.

LowLevelView.c

```
;/* LowLevelView.c - Execute me to compile me with Lattice 6.2
sc data=near nominc strmer streq nostkchk saveds ign=73 LowLevelView
quit
*/

#include <exec/memory.h>
#include <exec/libraries.h>
#include <graphics/view.h>
#include <graphics/gfxbase.h>
#include <graphics/videocontrol.h>
#include <graphics/monitor.h>

#include <graphics/displayinfo.h>
#include <hardware/custom.h>

#include <graphics/gfxmacros.h>

#include <clib/exec_protos.h>
#include <clib/graphics_protos.h>

extern struct GfxBase *GfxBase;
extern struct Library *IntuitionBase;
extern far struct Custom custom;

struct View *CreateAView(APTR, ULONG);
void DeleteAView(struct View *);
struct ViewPort *CreateAViewPort(APTR, ULONG, ULONG, ULONG, ULONG, ULONG);
void DeleteAViewPort(struct ViewPort *);

struct View *CreateAView(APTR mem_pool, ULONG modeid)
{
    struct ViewExtra *ve;
    struct View *view = NULL;

    if (view = AllocPooled(mem_pool, sizeof(struct View)))
    {
        InitView(view);

        if (ve = GfxNew(VIEW_EXTRA_TYPE))  /* For V36 and up, you need a ViewExtra if   */
        {                                  /* if you want to use a non-default monitor. */

            if (ve->Monitor = OpenMonitor(NULL, modeid))
            {
                GfxAssociate(view, ve);
                view->Modes |= EXTEND_VSTRUCT;  /* Mark the View as having a ViewExtra. */
            }
            else
            {
                GfxFree(ve);
                ve = NULL;
            }
        }
        if (!ve)
        {
            view = NULL;
        }

    }
    return(view);
}

void DeleteAView(struct View *view)
{
    struct ViewExtra *ve=NULL;

    if (ve = GfxLookUp(view))
    {
        if (ve->Monitor) CloseMonitor(ve->Monitor);
        GfxFree(ve);
    }
}
```


LowLevelView.c

```
struct ViewPort *CreateAViewPort(APTR mem_pool,
                                 ULONG sizex,
                                 ULONG sizey,
                                 ULONG depth,
                                 ULONG modeid,
                                 ULONG colors)
{
    struct ViewPort      *vp      = NULL;
    struct ViewPortExtra *vpextra = NULL;
    struct DisplayInfo   *disinfo = NULL;

    if ((1L<<depth) <= colors)                  /* There must be enough colors in the  */
    {                                           /* colormap for the ViewPort's bitmap. */
        if (vp = AllocPooled(mem_pool, sizeof(struct ViewPort)))
        {
            InitVPort(vp);        /* This function clears some of the ViewPort field so */
                                  /* call it before initializing any ViewPort fields.   */

            if (vp->ColorMap = GetColorMap(colors))   /* I need a ColorMap if I want to */
                                                      /* use certain VideoControl() features. */
            {
                if (vp->RasInfo = (struct RasInfo *)
                                  AllocPooled(mem_pool, sizeof(struct RasInfo)))
                {
                    if (vp->RasInfo->BitMap =
                            AllocBitMap(sizex, sizey, depth,
                                        BMF_DISPLAYABLE | BMF_CLEAR,
                                        NULL))
                    {
                        if (vpextra = GfxNew(VIEWPORT_EXTRA_TYPE))
                        {
                            if (disinfo = FindDisplayInfo(modeid))
                            {
                                vp->DWidth   = sizex;
                                vp->DHeight  = sizey;

                                if (!VideoControlTags(vp->ColorMap,

                                /* This tag associates a ColorMap with a ViewPort.      */
                                                VTAG_ATTACH_CM_SET,     vp,

                                /* This tag associates a ViewPortExtra with a ViewPort. */
                                /* Notice that VideoControl() (*not* GfxAssociate())    */
                                /* associates the VP and VPE.                           */
                                                VTAG_VIEWPORTEXTRA_SET, vpextra,

                                                VTAG_NORMAL_DISP_SET,   disinfo,
                                                VTAG_USERCLIP_SET,      NULL,
                                                TAG_END))
                                {
                                    if (AttachPalExtra(vp->ColorMap, vp))
                                        disinfo = NULL;
                                }
                            }
                            if (!disinfo) { GfxFree(vpextra); vpextra = NULL; }
                        }
                        if (!vpextra)
                        {
                            FreeBitMap(vp->RasInfo->BitMap);
                            vp->RasInfo->BitMap=NULL;
                        }

                    }
                    if (!(vp->RasInfo->BitMap)) { vp->RasInfo=NULL; }
                }
                if (!(vp->RasInfo)) { FreeColorMap(vp->ColorMap); vp->ColorMap=NULL; }
            }
            if (!(vp->ColorMap)) { vp=NULL; }
        }
    }
    return(vp);
}
```

LowLevelView.c

```
void DeleteAViewPort(struct ViewPort *vp)
{
    struct TagItem ti[2];

    ti[0].ti_Tag = VTAG_VIEWPORTEXTRA_GET;
    ti[0].ti_Data = NULL;                   /* VideoControl() will write over this with */
                                            /* ViewPortExtra address.                   */

    ti[1].ti_Tag = VTAG_END_CM;

    VideoControl(vp->ColorMap, ti);         /* Can't use VideoControlTags() here.       */
    if (ti[0].ti_Data)
    {
        GfxFree((APTR)ti[0].ti_Data);       /* Free the ViewPortExtra, if it exists.    */
    }
    FreeBitMap(vp->RasInfo->BitMap);
    FreeColorMap(vp->ColorMap);
}
```


LowLevelView.h

```
#include <exec/types.h>
#include <graphics/view.h>
#include <graphics/videocontrol.h>
#include <graphics/monitor.h>
#include <graphics/modeid.h>
#include <graphics/displayinfo.h>

/*#define SIZEX  320
#define SIZEY  200
#define DEPTH  4
#define MODEID (NTSC_MONITOR_ID | LORES_KEY)*/
#define COLORS 32

struct View *CreateAView(APTR, ULONG);
void DeleteAView(struct View *);
struct ViewPort *CreateAViewPort(APTR, ULONG, ULONG, ULONG, ULONG, ULONG);
void DeleteAViewPort(struct ViewPort *);
```

LLV.asm

```
        incdir  "include:"
        include "exec/execbase.i"
        include "graphics/gfxbase.i"
        include "graphics/view.i"
        include "graphics/videocontrol.i"
        include "graphics/gfxnodes.i"

        include "hardware/custom.i"

        XREF    _GfxBase
        XREF    _LVOAllocPooled
        XREF    _LVOInitView
        XREF    _LVOInitVPort
        XREF    _LVOGfxNew
        XREF    _LVOOpenMonitor
        XREF    _LVOCloseMonitor
        XREF    _LVOGfxFree
        XREF    _LVOGfxAssociate
        XREF    _LVODoRawIO
        XREF    _LVOGfxLookUp
        XREF    _LVOAllocBitMap
        XREF    _LVOFreeBitMap
        XREF    _LVOGetColorMap
        XREF    _LVOFreeColorMap
        XREF    _LVOFindDisplayInfo
        XREF    _LVOVideoControl
        XREF    _LVOAttachPalExtra

        XDEF    _CreateAView
        XDEF    _DeleteAView
        XDEF    _DeleteAViewPort
        XDEF    _CreateAViewPort

*********************************************************
* Other Macros
*********************************************************

SYSCALL     MACRO
        jsr _LVO1(a6)
        ENDM

*********************************************************

*
* struct View *     __asm CreateAView(register __a0 APTR view,
*                                     register __d0 ULONG modeid);
*
* void              __asm DeleteAView(register __a0 struct View *view);
*
* struct ViewPort * __asm CreateAViewPort(register __a0 APTR mem_pool,
*                                         register __d4 ULONG sizex,
*                                         register __d5 ULONG sizey,
*                                         register __d2 ULONG depth,
*                                         register __d6 ULONG modeid,
*                                         register __d7 ULONG colors);
*
* void              __asm DeleteAViewPort(register __a0 struct ViewPort *vp);
*

                section LLView,code

_CreateAView:
                MOVEM.L     D2/A2-A3/A6,-(SP)   ;save registers
                MOVE.L      D0,D2               ;save MODEID in D2 for later

                MOVEA.L     4.W,A6              ;Load ExecBase

                MOVE.L      #v_SIZEOF,D0        ;Want sizeof(struct View)
                SYSCALL     AllocPooled         ;Try to allocate a view
                MOVEA.L     D0,A2               ;cache the view address
                TST.L       D0                  ;
                BEQ.W       endCAV              ;branch if AllocPooled failed
```


LLV.asm

```
                MOVEA.L     A2,A1               ;set up view address for InitView
                MOVE.L      _GfxBase,A6         ;load graphics library

                SYSCALL     InitView
                MOVE.L      #VIEW_EXTRA_TYPE,D0
                SYSCALL     GfxNew              ;Ask OS for a ViewExtra
                TST.L       D0                  ;
                BEQ.B       endCAV              ;branch if GfxNew failed

OpenMon:        MOVEA.L     D0,A3               ;Cache viewextra pointer
                MOVE.L      #0,A1               ;NULL monitor name
                MOVE.L      D2,D0               ;Put MODEID in place for syscall
                SYSCALL     OpenMonitor
                TST.L       D0                  ;
                BEQ.B       UnGfxNew            ;clean up if if OpenMon failed

GfxAss:         MOVE.L      D0,ve_Monitor(A3)   ;Fill in the ViewExtra's Monitor field
                MOVEA.L     A2,A0               ;set up view pointer
                MOVEA.L     A3,A1               ;set up viewextra pointer
                SYSCALL     GfxAssociate        ;
                ORI.L       #EXTEND_VSTRUCT,v_Modes(A2) ;Set EXTEND_VSTRUCT in View->Modes

endCAV:         MOVE.L      A2,D0               ;make view pointer the return value
                MOVEM.L     (SP)+,D2/A2-A3/A6
                RTS

UnGfxNew:       MOVEA.L     A3,A0               ;Set up ViewExtra address
                SYSCALL     GfxFree             ; and relinquish it
                BRA.B       endCAV

_DeleteAView:
                MOVEM.L     A2/A6,-(SP)
                MOVE.L      _GfxBase,A6
                SYSCALL     GfxLookUp           ;Find the View's ViewExtra
                TST.L       D0
                BEQ.W       endDAV
                MOVEA.L     D0,A2

                TST.L       ve_Monitor(A2)
                BEQ.W       endDAV

                MOVE.L      ve_Monitor(A2),A0   ;If there is an open MonitorSpec, close it
                SYSCALL     CloseMonitor

                MOVEA.L     A2,A0               ;Free the ViewExtra
                SYSCALL     GfxFree
endDAV:         MOVEM.L     (SP)+,A2/A6
                RTS


_CreateAViewPort:
                MOVEM.L     D3/A2-A6,-(SP)
                MOVEA.L     A0,A3           ;save mem_pool address for later

                MOVE.L      #1.L,D0         ;parameter checking:
                LSL.L       D2,D0           ; make sure the #colors is not less than the
                CMP.L       D0,D7           ; bitplane depth implies. There must be at least
                BPL.B       4$              ; enough colors in the colormap to support the
                MOVE.L      #0.L,D0         ; bitplane depth.
                BRA.W       endCAVP

4$:             MOVEA.L     4.W,A6
                MOVE.L      #vp_SIZEOF,D0
                SYSCALL     AllocPooled         ;Allocate A ViewPort from the mem_pool

                TST.L       D0                  ;
                BEQ.W       endCAVP             ;AllocPool failed

                LEA         attcmset_tag,A0
                MOVE.L      D0,(A0)             ;Store VPort in VideoControl tag
                MOVEA.L     D0,A2               ;cache viewport address
```

LLV.asm

```
                MOVEA.L     _GfxBase,A6
                MOVEA.L     A2,A0
                SYSCALL     InitVPort           ;

                MOVE.L      D7,D0               ;D7 contains the number of colors
                SYSCALL     GetColorMap
                TST.L       D0
                BEQ.W       endCAVP

                MOVE.L      D0,vp_ColorMap(A2)  ;Store ColorMap pointer in VPort
                MOVEA.L     D0,A5               ;cache ColorMap

                MOVEA.L     4.W,A6
                MOVEA.L     A3,A0               ;mem_pool address
                MOVE.L      #ri_SIZEOF,D0       :allocate a RasInfo
                SYSCALL     AllocPooled
                MOVEA.L     _GfxBase,A6
                TST.L       D0                  ;
                BEQ.W       UnGetCM             ;branch if AllocPooled failed

                MOVE.L      D0,vp_RasInfo(A2)   ;store RasInfo pointer in VP
                MOVEA.L     D0,A3               ;cache RasInfo pointer (finished
w/mem_pool)
                MOVE.L      D4,D0
                MOVE.L      D5,D1
                MOVE.L      #(BMF_DISPLAYABLE|BMF_CLEAR),D3
                MOVEA.L     #0.W,A0
                SYSCALL     AllocBitMap
                TST.L       D0
                BEQ.W       UnGetCM

                MOVE.L      D0,ri_BitMap(A3)    ;Store BitMap pointer in cached rasinfo
                MOVE.L      #VIEWPORT_EXTRA_TYPE,D0
                SYSCALL     GfxNew              ;Get a VPExtra
                TST.L       D0
                BEQ.W       UnGetBM

                LEA         vpeset_tag,A0
                MOVE.L      D0,(A0)             ;Store VPE in its VideoControl tag

                MOVE.L      D6,D0               ;load modeid
                SYSCALL     FindDisplayInfo
                TST.L       D0
                BEQ.W       UnGetVPE

                LEA         dispset_tag,A0
                MOVE.L      D0,(A0)             ;Store displayinfo in its VideoControl tag
                MOVE.W      D4,vp_DWidth(A2)    ;set up its DWidth/DHeight
                MOVE.W      D5,vp_DHeight(A2)

                MOVEA.L     A5,A0               ;load cached CM
                LEA         vidtags,A1          ;load videocontrol() tags
                SYSCALL     VideoControl
                TST.L       D0
                BNE.W       UnGetVPE

                MOVEA.L     A5,A0               ;copy CM
                MOVEA.L     A2,A1               ;copy VP
                SYSCALL     AttachPalExtra
                TST.L       D0
                BNE.W       UnGetVPE        ;Clean up if AttachPalExtra() returns an error

                MOVE.L      A2,D0               ;Make the VP the return value

endCAVP:        MOVEM.L     (SP)+,D3/A2-A6
                rts

UnGetVPE:       LEA         vpeset_tag,A1       ;Load VPortExtra address
                MOVEA.L     (A1),A0
                SYSCALL     GfxFree             ; ...and relinquish it
```


LLV.asm

```
UnGetBM:        MOVEA.L     ri_BitMap(A3),A0    ;Load BitMap and relinquish
                SYSCALL     FreeBitMap

UnGetCM:        MOVE.L      vp_ColorMap(A2),A0  ;Load ColorMap
                SYSCALL     FreeColorMap        ; ... and relinquish
                MOVE.L      #0.L,D0             ; return value = NULL
                BRA.W       endCAVP

_DeleteAViewPort:
                MOVEM.L     A2/A6,-(SP)
                MOVEA.L     A0,A2               ;cache VPort address

                MOVE.L      _GfxBase,A6

                MOVEA.L     vp_ColorMap(A2),A0  ;Load ColorMap address
                LEA         getvpe_tag,A1

                SYSCALL     VideoControl        ;find the VPort's VPortExtra with the
                                                ;VTAG_VIEWPORTEXTRA_GET tag

                MOVE.L      (getvpe_result),D0
                TST.L       D0
                BEQ.W       2$
                MOVEA.L     D0,A0
                SYSCALL     GfxFree             ;If there is a VPE, free it

2$:             MOVEA.L     vp_RasInfo(A2),A1   ;load the RasInfo's BitMap...
                MOVEA.L     ri_BitMap(A1),A0
                SYSCALL     FreeBitMap          ;...and free it
                MOVEA.L     vp_ColorMap(A2),A0  ;load and free ColorMap
                SYSCALL     FreeColorMap

endDAVP:        MOVEM.L     (SP)+,A2/A6
                RTS


                section vidtags,data            ;The tags for VideoControl from
CreateAViewPort
                CNOP 0,4
vidtags:        dc.l        VTAG_ATTACH_CM_SET
attcmset_tag:   dc.l        0,VTAG_VIEWPORTEXTRA_SET
vpeset_tag:     dc.l        0,VTAG_NORMAL_DISP_SET
dispset_tag:    dc.l        0,VTAG_USERCLIP_SET
uclipset_tag:   dc.l        0,TAG_END

getvpe_tag:     dc.l        VTAG_VIEWPORTEXTRA_GET
getvpe_result:  dc.l        0,VTAG_END_CM
```

LLV.h

```
#include <exec/types.h>
#include <graphics/view.h>
#include <graphics/videocontrol.h>
#include <graphics/monitor.h>
#include <graphics/modeid.h>
#include <graphics/displayinfo.h>

/*#define SIZEX  320
#define SIZEY  200
#define DEPTH  4
#define MODEID (NTSC_MONITOR_ID | SUPERHIRES_KEY)*/
#define COLORS 32

struct View *     __asm CreateAView(register __a0 APTR view,
                                    register __d0 ULONG modeid);

void              __asm DeleteAView(register __a0 struct View *view);

struct ViewPort * __asm CreateAViewPort(register __a0 APTR mem_pool,
                                        register __d4 ULONG sizex,
                                        register __d5 ULONG sizey,
                                        register __d2 ULONG depth,
                                        register __d6 ULONG modeid,
                                        register __d7 ULONG colors);

void              __asm DeleteAViewPort(register __a0 struct ViewPort *vp);
```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4 Includes and Autodocs

This section lists the Autodocs (function descriptions) and include (header) files for the new system software modules present in the Amiga CD^{32} game machine. The following V40 system modules are covered here:

- ❍ lowlevel.library — Provides functions for timing, interrupts, reading the game controller, handling the keyboard and suspending the Amiga's multitasking OS.
- ❍ nonvolatile.library — Interface to the nonvolatile RAM or equivalent storage. This allows players to quit a game and later resume where they left off, even if power was off in the interim.
- ❍ cd.device — This is the lower-level interface to the CD-ROM subsystem. It follows the conventions of Amiga Exec devices.

The latest includes and Autodocs for all the other system modules are available directly from Commodore; contact your local support manager. For additional informtion, refer to the *Amiga Technical Reference Series* published by Addison-Wesley. The volumes in this series are as follows:

- ❍ *Amiga ROM Kernel Reference Manual: Includes and Autodocs*, 3rd edition, ISBN 0-201-56773-3 ($38.95 US). These are the include files and Autodoc function desriptions that correspond to Release 2 (V37 of the operating system).
- ❍ *Amiga ROM Kernel Reference Manual: Libraries,* 3rd edition, ISBN 0-201-56774-1 ($38.95 US). Tutorial information with lots of examples on how to use the Amiga's system of resident, re-entrant function libraries. Covers graphics, Intuition and Exec.
- ❍ *Amiga ROM Kernel Reference Manual: Devices,* 3rd edition, ISBN 0-201-56775-X ($28.95 US). Tutorial information with lots of examples on how to control the Amiga's standard device interface and all the system devices. Also covers the IFF file sharing standard.
- ❍ *Amiga Hardware Reference Manual,* 3rd edition, ISBN 0-201-56776-8 ($28.95 US). Detailed explanations of how the Amiga's hardware components and custom chips work.
- ❍ *Amiga User Interface Style Guide,* 3rd edition, ISBN 0-201-57757-7 ($21.95 US). A functional specification for applications that use Amiga's powerful user interface facilities.

Detailed information on the Amiga's DOS is published by Bantam Books:

- ❍ *Amiga DOS Manual*, 3rd edition, ISBN 0-553-35403-5 ($24.95 US). This contains the include file listings and Autodocs for the DOS subsystem in Release 2 (V37). Also has tutorial information and examples showing how to use DOS commands, scripts, etc.

AddKBInt

NAME

AddKBInt - Adds routine to the keyboard interrupt.

SYNOPSIS

```
Handle = AddKBInt(IntRoutine, IntData)
d0                 a0         a1

APTR AddKBInt(APTR, APTR)
```

FUNCTION

This routine extends the functionality of the keyboard interrupt to include IntRoutine. Since this is an extention of the normal keyboard interrupt all of the keyboard handshaking is handled. The keyboard error codes are filtered out and not passed to IntRoutine.

When a keyboard interrupt occurs the routine pointed to by InitRoutine is called. As with any other assembly routines d0, d1, a0 and a1 can be considered scratch, all other registers must have their values preserved. However, upon exit d0 MUST be cleared. When the IntRoutine is invoked a1 will contain IntData; also d0 will contain the raw key code read from the keyboard.

IntRoutine will not be called when a reset is recieved from the keyboard..

NOTE

The routine added should be as short as possible since it will be run for every keypress and release.

This is a low level function that does not fit the normal Amgia multitasking model. The interrupt installed will have no knowledge of which window/screen currently has input focus.

If your program is to exit without reboot, you MUST call RemKBInt() before exiting.

Only one interrupt routine may be added to the system. ALWAYS check the return value in case some other task has previously used this function.

The Exec Interrupt structure is used for controlling the invokation of IntRoutine. All of the register conventions of interrupt server are observed. This means two additional scratch registers are available; a5 (which will contain the address of IntRoutine) and a6. The priority used (not that it matters since only one routine is possible) is zero.

INPUTS

IntRoutine - Pointer to the interrupt routine invoked every keyboard interrupt.
IntData - Data passed to the interrupt routine in register a1. If more than one long word of data is required this should be a pointer to structure that contains the required data.

RESULT

Handle - Pointer to the handle used in manipulating the interrupt. NULL if it was not possible create the interrupt.

SEE ALSO:

RemKBInt ()

AddTimerInt

NAME

AddTimerInt - Adds an interrupt that is executed at regular intervals

SYNOPSIS

```
TimerIntHandle = AddTimerInt(IntRoutine, IntData)
d0                           a0          a1

APTR AddTimerInt(APTR, APTR)
```

FUNCTION

Calling this routine causes the system to allocate a CIA timer and set up IntRoutine to service any interrupts cause by the timer. Although the timer is allocated it is neither running, nor enabled. StartIntTimer must be called to establish the time interval and start the timer.

When the interrupts occur the routine pointed to by IntRoutine is called. As with any other assembly routines d0, d1, a0 and a1 can be considered scratch, all other registers must have their values preserved. However, upon exit d0 MUST be cleared. When the interrupt routine is invoked a1 will contain the value passed to this routine as IntData.

Only a single CIA timer will be allocated by this routine. So this routine may only be called once without an intervening call to RemTimerInt. The CIA timer used by this routine is not guaranteed to always be the same. This routine utilizes the CIA resource and uses an unallocated CIA timer.

NOTE

If your program is to exit without reboot, you MUST match all calls to this function with calls to RemTimerInt before exiting.

Even if you only use the function once in your program; checking the return value will make your program more tolerant for mulititasking on the Amiga computers.

INPUTS

IntRoutine - Pointer to the interrupt routine invoked ever TimeInterval

IntData - Data passed to the interrupt routine in register a1. If more than one long word of data is required this should be a pointer to structure that contains the required data.

RESULT

TimerIntHandle - Pointer to the handle used in manipulating the timer interrupt. NULL if it was not possible create the interrupt.

SEE ALSO:

RemTimerInt(), StopTimerInt(), StartTimerInt()

AddVBlankInt

NAME

AddVBlankInt - Adds routine executed every vertical blank.

SYNOPSIS

```
Handle = AddVBlankInt(IntRoutine, IntData)
d0                    a0          a1

APTR AddVBlankInt(APTR, APTR)
```

FUNCTION

When the VBLANK occurs the routine pointed to by IntRoutine is called. As with any other assembly routines d0, d1, a0 and a1 can be considered scratch, all other registers must have their values preserved. However, upon exit d0 MUST be cleared. When the interrupt routine is invoked a1 will contain the value passed to this routine as IntData

NOTES

If your program is to exit without reboot, you MUST call RemVBlankInt before exiting. Only one interrupt routine may be added to the system. ALWAYS check the return value in case some other task has previously used this function.

INPUTS

IntRoutine - Pointer to the interrupt routine invoked every vertical blank.
NOTE: This routine should be as short as possible to minimize its effect to overall system preformance.

IntData - Data passed to the interrupt routine in register a1. If more than one long word of data is required this should be a pointer to structure that contains the required data.

RESULT

Handle - Pointer to the handle used in manipulating the interrupt. NULL if it was not possible create the interrupt.

SEE ALSO:

RemVBlankInt

ElapsedTime

NAME

ElapsedTime - Returns the time elapsed since it was last called.

SYNOPSIS

```
FractionalSeconds = ElapsedTime(Context)
d0                              a0

ULONG ElapsedTime(struct EClockVal *)
```

FUNCTION

This function utilizes the timer.device call ReadEClock to get an accurate elaspsed time value. Since the context needs to be established the first call to this routine will return a nonsense value.

NOTE

The return value for this function only allows for sixteen bits worth for the integer number of seconds and sixteen bits for the factional number of seconds.

With sixteen bits worth of integer seconds this function can be used to timer an interval upto about 16 hours. If the actual time interval is larger this function will return this maximum value.

The sixteen bits for fractional seconds gives a resolution of approximately 20 microseconds. However, it is not recomended to expect this function to be accurate for a time interval of less than 200 microseconds.

INPUTS

Context - Pointer to an EClockVal structure, two ULONGs. This was the value returned from ReadEClock when this function was last called.

RESULT

FractionalSeconds - The elapsed time as a fixed point thirty two bit number with the point fixed in the middle. That is, the upper order sixteen bits represent the number of seconds elapsed. The low order sixteen bit represent the fractional number of seconds elapsed. This value is limited to about sixteen hours. Although this value is precise to nearly 20 microseconds it is only accurate to within 200 microseconds.

SEE ALSO:

timer.device/ReadEClock()

GetKey

NAME

GetKey - Returns the currently pressed raw key code and qualifiers.

SYNOPSIS

```
Key = GetKey ()
d0

ULONG GetKey (VOID)
```

FUNCTION

This function returns the currently pressed non-qualifier key and all pressed qualifiers.

This function is safe within an interrupt.

NOTE

This is a low level function that does not fit the normal Amgia multitasking model. The values returned by this function are not modified by which window/screen currently has input focus.

INPUTS

None

RESULT

Key - key code for the last non-qualifier key pressed is in the low order word. If no key is pressed this word will be FF. The upper order word contains the qualifiers which can be found within the long word as follows:

Qualifier	Key
LLKB_LSHIFT	Left Shift
LLKB_RSHIFT	Rigt Shift
LLKB_CAPSLOCK	Caps Lock
LLKB_CONTROL	Control
LLKB_LALT	Left Alt
LLKB_RALT	Right Alt
LLKB_LAMIGA	Left Amiga
LLKB_RAMIGA	Right Amiga

GetLanguageSelection

NAME

GetLanguageSelection - Returns the current language selection.

SYNOPSIS

```
Language = GetLanguageSelection()
d0

ULONG GetLanguageSelection (VOID)
```

FUNCTION

Determine what the user has specified as a language.

INPUTS

None

RESULT

Language - User specified language, or zero if none has yet been specified.

QueryKeys

NAME

QueryKeys - Returns the states for a set of keys.

SYNOPSIS

```
QueryKeys (QueryArray, ArraySize)
           a0          d1

VOID QueryKeys(struct KeyQuery *, UBYTE)
```

FUNCTION

Scans the keyboard to determines which, if any, of the raw key codes listed in the QueryArray are currently pressed. The state for each code is returned in the array. This function may be invoked from within an interrupt, but the size of QueryArray should be kept as small as possible.

NOTE

This is a low level function that does not fit the normal Amgia multitasking model. The values returned have no knowledge of which window/screen currently has input focus.

INPUTS

QueryArray - Pointer to a block of memory that consists of raw key codes alternated with the state, filled in by this function, of that key.

ArraySize - Number of keycode entries in QueryArray.

RESULT

None

ReadJoyPort

NAME

ReadJoyPort - Return the state of the selected joy/mouse port.

SYNOPSIS

```
PortState = ReadJoyPort(PortNumber)
d0                      d0

ULONG ReadJoyPort(ULONG);
```

FUNCTION

This function is used to determine what device is attached to the joy port and the current position/button state. The user may attach a Mouse, Game Controller, or Joystick to the port and this function will dynamically detect which device is attached and return the appropriatly formatted PortState.

To determine the type of controller that is attached, this function will clock the Game Controller and/or interpret changes in the joy port data. Valid clocked data from the Game Controller is immediatly detected. However, to accuratly determine if a mouse or joystick is attached, several calls to this function are required along with some movement at the joy port by the user.

This function always executes immediatly.

NOTE

This is a low level single threaded function that does not fit the normal Amgia multitasking model. Only one process can be executing this routine at any time. All others will return immediately with JP_TYPE_NOTAVAIL.

The nature of this routine is not meant to encourage nonmultitasking friendly programming practices like polling loops. If your task is waiting for a transition to be returned use a WaitTOF() between calls to minimize the total system impact.

When called the first time for each port this function attempts to acquire certain system resources. In order to aquire these resources this function MUST be called from a task, or a DOS process. If this function fails to aquire the necessary resources the function will return with JP_TYPE_NOTAVAIL. Once the resources are aquired (return value other than JP_TYPE_NOTAVAIL) this function may be used in interrupts.

INPUTS

PortNumber - Unsigned long that selects the port to read. This value should be in the range of 0..1.

RESULT

PortState - Bit map that identifys the device and the current state of that device. The format of the bit map is dependant on the type of device attached.

The following constants (defined in <libraries/lowlevel.i>and <libraries/lowlevel.h>)can be used to determine which device is attached and the state of that device :

The type of device can be determined by applying the mask JP_TYPE_MASK to the return value and comparing the resultant value with the following:

JP_TYPE_NOTAVAIL	port data unavailable
JP_TYPE_GAMECTLR	game controller
JP_TYPE_MOUSE	mouse
JP_TYPE_JOYSTK	joystick
JP_TYPE_UNKNOWN	unknown device

If type =	JP_TYPE_GAMECTLR,	the bit map of PortState is:
	JPF_BUTTON_BLUE	Blue - Stop
	JPF_BUTTON_RED	Red - Select
	JPF_BUTTON_YELLOW	Yellow - Repeat
	JPF_BUTTON_GREEN	Green - Shuffle
	JPF_BUTTON_FORWARD	Charcoal - Forward
	JPF_BUTTON_REVERSE	Charcoal - Reverse
	JPF_BUTTON_PLAY	Grey - Play/Pause
	JPF_JOY_UP	Up
	JPF_JOY_DOWN	Down
	JPF_JOY_LEFT	Left
	JPF_JOY_RIGHT	Right

If type =	JP_TYPE_JOYSTK,	the bit map of PortState is:
	JPF_BUTTON_BLUE	Right
	JPF_BUTTON_RED	Fire
	JPF_JOY_UP	Up
	JPF_JOY_DOWN	Down
	JPF_JOY_LEFT	Left
	JPF_JOY_RIGHT	Right

If type =	JP_TYPE_MOUSE,	the bit map of PortState is:
	JPF_BUTTON_BLUE	Right mouse
	JPF_BUTTON_RED	Left mouse
	JPF_BUTTON_PLAY	Middle mouse
	JP_MVERT_MASK	Mask for vertical counter
	JP_MHORZ_MASK	Mask for horizontal counter

lowlevel.library

RemKBInt

NAME

RemKBInt - Remove a previously installed keyboard interrupt.

SYNOPSIS

```
RemKBInt(Handle)
         a1

VOID RemKBInt(APTR)
```

FUNCTION

Remove a keyboard interrupt routine previously added with AddKBInt. Additionally, any resources involved in the interrupt will be freed.

INPUTS

Handle - Pointer to the handle returned from AddKBInt. This can be NULL.

RESULT None

SEE ALSO:

AddKBInt ()

RemTimerInt

NAME

RemTimerInt - Remove the previously installed timer interrupt.

SYNOPSIS

```
RemTimerInt(TimerIntHandle)
            a1

VOID RemTimerInt(APTR)
```

FUNCTION

Calling this routine causes the system to remove a timer interrupt routine previously added with AddTimerInt. Additionally any timer resources involved in the timer interval will be freed.

INPUTS

TimerIntHandle - Pointer to the handle returned from AddTimerInt. This must not be NULL or serious problems will occur.

RESULT None

SEE ALSO:

AddTimerInt(), StopTimerInt(), StartTimerInt()

RemVBlankInt

NAME
RemVBlankInt - Remove a previously installed vertical blank routine.

SYNOPSIS
```
RemVBlankInt(Handle)
             a1

VOID RemVBlankInt(APTR)
```

FUNCTION
Remove a vertical blank interrupt routine previously added with AddVBlankInt. Additionally, any resources involved in the interrupt will be freed.

INPUTS
Handle - Pointer to the handle returned from AddVBlankInt.

RESULT
None

SEE ALSO:
AddVBlankInt

StartTimerInt

NAME
StartTimerInt - Start the timer associated with the timer interrupt.

SYNOPSIS
```
StartTimerInt(TimerIntHandle, TimeInterval, Continuous)
              a1              d0            d1

VOID StartTimerInt(APTR, ULONG, BOOL)
```

FUNCTION
This routine restarts a stopped timer that is assocatied with a timer interrupt created by AddTimerInt. Before the timer is started the time interval is reset.

INPUTS

TimerIntHandle -	Pointer to the handle returned from AddTimerInt. This must not be NULL or serious problems will occur.
TimeInterval -	Number of micoseconds between interrupts. The maximum value allowed is 90,000. If higher values are passed there will be unexpected results.
Continuous -	FALSE for a one shot interrupt. TRUE for multiple interrupts.

RESULT
None

SEE ALSO:
AddTimerInt(), RemTimerInt(), StopTimerInt()

StopTimerInt

NAME
StopTimerInt - Stop the timer associated with the timer interrupt.

SYNOPSIS
```
StopTimerInt(TimerIntHandle)
             a1

VOID StopTimerInt(APTR)
```

FUNCTION
Calling this routine causes the system stop the timer associated with the timer interrupt handle passed.

INPUTS

TimerIntHandle -	Pointer to the handle returned from AddTimerInt. This must not be NULL or serious problems will occur.

RESULT None

SEE ALSO:
AddTimerInt(), RemTimerInt(), StartTimerInt()

SystemControlA

NAME

SystemControlA	- Method for selectively disabling OS features.
SystemControl	- varargs stub for SystemControlA().

SYNOPSIS
```
FalTag = SystemControlA (tagList)
d0                       a1

ULONG SystemControlA (struct TagItem *);

Failure = SystemControl(firsttag, ...)

ULONG SystemControl(Tag, ...);
```

FUNCTION

This function is used to alter the operation of the system. Some of the alterations involving controlling what are normally regarded as system resources. In order to minimize confusion only one task is allowed to control any part of the system resources. This prevents the possiblity of two task fighting each controlling a part of the system. If the tag is identified as task exculsive it means that only one task can hold (set to TRUE) any one of the tags. If another task attempts to set any of these tags TRUE the call to SystemControl will fail.

It is important to remember that SystemControlA can fail.

NOTE

This is a low level function and certain tags do not fit the normal Amgia multitasking model.

INPUTS

tagList - pointer to an array of tags listing the features of the system to be enabled/disabled.

TAGS

SCON_TakeOverSys:

TRUE - Takes over the CPU to ensure that a program gets every ounce of CPU time (with the exception of crucial interrupts). When in this mode, the CPU will belong completely to the program. Task switching will be disabled and the program will get the all CPU cycles. This means any calls to the OS that involve multitasking in some way will not execute. Other tasks will not run until this tag is used with the data FALSE. However, during a Wait() on a signal, multitasking will automatically be turned back on until the signal is recieved. Once recieved,multitasking will again be disabled and the CPU will be exclusive to the owning program.

FALSE - Relinquishes the CPU and reenables multitasking. This tag is task exculsive. This tag nests. A task may take over the CPU several times before relinquishing it. However, there must be a matching number of calls.

SCON_KillReq:

TRUE - Disables system requesters. These are the reasons for NOT disabling system requesters:

1. No calls in the program will cause a system requester.
2. The only thing that could cause a requester to appear is the lack of a CD in the drive and SCON_CDReboot is CDReboot_On, therefore a requester can't appear.
3. The only disk I/O is via a CD with SCON_CDReboot set to CDReboot_On and/or nonvolatile.library.

When requesters should not be disabled (GAME PROGRAMS):
No DOS calls are used after loading; or SCON_CDReboot is CDReboot_On; and nonvolatile.library is used for loading and saving user data. This fits the above case since; After loading either DOS calls are not used fitting reason 1, or the game is accessing the CD and has SCON_CDReboot set to CDReboot_On fitting reason 2. The game accesses high scores, game position, etc through the nonvolatile.library meeting the reason 3.

FALSE - Enables requesters for the program. This tag nests. Tasks may disable requesters several times before enabling them. However, there must be a matching number of calls.

SCON_CDReboot:

CDReboot_On - Ejecting the CD will cause a reboot of the system. Use this only if the program cannot deal with error conditions.

CDReboot_Off - Ejecting the CD will not cause a reboot of the system. Use this if the program needs to insert CDs while running.

CDReboot_Default - Restore the default reboot behaviour for this system. This should be used upon exit, if this tag had been used to change the reboot behaviour. For the game machine this value is synonomous with CDReboot_On. For Amiga computers this value is synonomous with CDReboot_Off.

NOTE: The default reboot behaviour differs depending on the platform. If a program requires a specific behaviour it must use this function to set the behaviour. For example, a CD audio mixer would use this tag with the data CDReboot_Off. This will allow the changing of audio CDs on the game machine as well as Amiga computers.

If, however, there is no error detection code at all this tag should be used with the data CDReboot_On.

It is hoped that no program will require CDReboot_On. If all programs check for error condition and recover gracefully such a call should never be necessary. With the default behavior the games machine will always reset on disk ejects, and programs run from Amiga will not reset. Thus the leaving the default will increase the market for a program to include both types of platforms. This tag does not nest.

SCON_StopInput:

TRUE - Stop input.device from using any CPU. Also prevents input.device from passing along any events from either the keyboard and/or port 0. This tag is task exclusive. This tag is NOT reversable. Attempting to reverse will result in confused/garbled input events.

SCON_AddCreateKeys:
unit - Create raw keycodes for the joystick/game controller on unit. The unit value is checked for validity and must be either zero, or one. Each different unit value results in some code added to the VBlank interrupt chain. This tag nests. The tag SCON_RemCreateKeys is used to undo this tag. Tasks may create keycodes several times before stopping them. However, there must be a matching number of calls.

SCON_RemCreateKeys:
unit - Stop raw keycodes for the joystick/game controller on unit. The unit value is checked for validity and must be either zero, or one. This tag is used to match SCON_AddCreateKeys.

RESULT

FailTag - Zero if all tags succeeded. If non zero indicates a tag that has failed. It is possible that other tags may fail as well.

If any tag fails there will be no change in the system due to other tags.

lowlevel.library

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nonvolatile.library

DeleteNV

NAME

DeleteNV - Remove an entry from nonvoltatile storage

SYNOPSIS

```
Success = DeleteNV (AppName, ItemName)
d0                  a0       a1

BOOL DeleteNV (STRPTR, STRPTR)
```

FUNCTION

Searches the nonvolatile storage for the indicated entry and removes it.

INPUTS

AppName - NULL terminated string identifing the application that created the data.

ItemName - NULL terminated string uniquely identifing the data within the application.

RESULT

Success - TRUE will be returned if the entry is found and deleted. If the entry is not found FALSE will be returned

---

FreeNVData

NAME

FreeNVData - Release the memory allocated by a function of this library.

SYNOPSIS

```
FreeNVData (Data)
           a1\
VOID FreeNVData (APTR)
```

FUNCTION

Frees a block of memory that was allocated by any of the following: GetCopyNV(), GetNVInfo(), GetNVList().

INPUTS

Data - Pointer to the memory block to be freed.

RESULT

None

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SEE ALSO
GetCopyNV(), GetNVInfo(), GetNVList()

GetCopyNV

NAME
GetCopyNV - Returns an items stored in nonvolatile storage.

SYNOPSIS
```
Data = GetCopyNV (AppName, ItemName)
d0                 a0       a1

APTR GetCopyNV (STRPTR, STRPTR)
```

FUNCTION
Seaches the nonvolatile storage for the indicated AppName and ItemName. A pointer to a copy of this data will be returned.

INPUTS
AppName - NULL terminated string indicating the application name to be found.
ItemName - NULL terminated string indicated the item within the application to be found.

RESULT
Data - Pointer to a copy of data found in the nonvolatile storage assocated with AppName and ItemName. NULL will be returne if there is insufficient memory, or the AppName/ItemName does not exist.

SEE ALSO
FreeNVData()

GetNVInfo

NAME
GetNVInfo - Reports information on the current nonvolatile storage

SYNOPSIS
```
Information = GetNVInfo ()
d0

struct NVInfo * GetNVInfo (VOID)
```


FUNCTION
Finds the user's preferred nonvolatile device and reports information about it.

INPUTS
None.

RESULT
Information - Pointer to an NVInfo structure.

SEE ALSO
FreeNVData()

GetNVList

NAME
GetNVList - Returns a list of the items stored in nonvolatile storage.

SYNOPSIS
```
List = GetNVList (AppName)
d0                a0

struct MinList * GetNVList (STRPTR)
```

FUNCTION
Returns an array of structures about the items stored in the nonvolatile storage. Each element in the array consists of a pointer to a NULL terminated string, a LONG indicating the size of the item and a LONG indicated the protection of the item.

The array will be terminated by a element that with an indicated size of zero. The pointer of this element will point to the AppName.

INPUTS
AppName - NULL terminated string indicating the application name to be matched.

RESULT
List - A pointer to a Exec MinLiat of NVEntrys. A NULL will be returned if there is insufficient memory. If there are no entries in the nonvolatile storage for the AppName an empty list will be returned.

NOTE

The protection field contains more bits than are required for storing the delete protection status. These bits are reserved for other system usage and may not be zero. When checking for the delete status use either the field mask NVIF_DELETE, or the bit definition NVIB_DELETE.

SEE ALSO

FreeNVData(), SetNVProtection()

SetNVProtection

NAME

SetNVProtection - Sets the protection flags.

SYNOPSIS

```
Success = SetNVProtection (AppName, ItemName, Mask)
d0                         a0       a1        d2

BOOL SetNVProtection (STRPTR, STRPTR, LONG)
```

FUNCTION

Sets the protection attributes for a Item currently stored on the nonvolatile device.

Although Mask is LONG only the delete bit, NVEF_DELETE/NVEB_DELETE, may be set. If any other bits are set this function WILL CRASH.

INPUTS

AppName - Pointer to a NULL terminated string.
ItemName - Pointer to a NULL terminated string. AppName and ItemName together uniquely identify the data.
Mask - The new protection mask. Only set the delete bit otherwise this function WILL CRASH.

RESULT

Success - FALSE if the protection could not be change (ie the data does not exist).

SEE ALSO

GetNVList()

StoreNV

NAME

StoreNV - Store data in nonvolatile storage.

SYNOPSIS

```
Error = StoreNV (AppName, ItemName, Data, Length)
d0               a0       a1        a2    d0

UWORD StoreNV (STRPTR, STRPTR, APTR, ULONG)
```

FUNCTION

Saves some data in nonvolatile storage. The data is tagged with AppName and ItemName so it can be retrieved later. No single item should be larger than one fourth of the maximum storage as returned by GetNVInfo().

The string, AppName and ItemName, should be short, but descriptive. They need to be short since nonvolatile storage for a stand alone game system is limited. The game system allows the user to selectively remove entries from storage, so the string should be desriptive.

INPUTS

AppName - NULL terminated string identifying the application creating the data.
ItemName - NULL terminated string uniquely identifying the data within the application.
Data - Pointer to the memory block to be stored.
Length - Number of bytes to be stored in the units of tens of bytes. ie If you have 23 bytes to store length = 3; 147 byte then length = 15.

RESULT

Error:
0 - Data stored, no error.
NVERR_BADNAME - Error in AppName, or ItemName.
NVERR_WRITEPROT - Nonvolatile storage is read only.
NVERR_FAIL - Failure in writing data (nonvolatile storage full, or write protected).
NVERR_FATAL - Fatal error when accessing nonvolatile storage, possible loss of previously saved nonvolatile data.

SEE ALSO

GetCopyNV(), GetNVInfo()

CDADDCHANGEINT

NAME

CD_ADDCHANGEINT -- add a disk change software interrupt handler.

FUNCTION

This command lets you add a software interrupt handler to the disk device that gets invoked whenever a disk insertion or removal occurs.

You must pass in a properly initialized Exec Interrupt structure and be prepared to deal with disk insertions/removals immediately. The interrupt is generated by the exec Cause function, so you must preserve A6.

To set up the handler, an Interrupt structure must be initialized. This structure is supplied as the io_Data to the CD_ADDCHANGEINT command. The handler then gets linked into the handler chain and gets invoked whenever a disk change happens. You must eventually remove the handler before you exit.

This command only returns when the handler is removed. That is, the device holds onto the IO request until the CD_REMCHANGEINT command is executed with that same IO request. Hence, you must use SendIO() with this command.

IO REQUEST INPUT

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_ADDCHANGEINT
io_Length	sizeof(struct Interrupt)
io_Data	pointer to Interrupt structure

IO REQUEST RESULT

io_Error	0 for success, or an error code as defined in <devices/cd.h>

SEE ALSO

CD_REMCHANGEINT, <devices/cd.h>,<exec/interrupts.h>,exec.library/Cause()

CDADDFRAMEINT

NAME

CD_ADDFRAMEINT -- add a CD-frame software interrupt handler.

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_ADDFRAMEINT
io_Length	sizeof(struct Interrupt)
io_Data	pointer to Interrupt structure

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>

FUNCTION

This command lets you add a software interrupt handler to the disk device that gets invoked whenever a new frame is encountered while CD audio is being played.

You must pass in a properly initialized Exec Interrupt structure and be prepared to deal with frame interrupts immediately. The interrupt is generated by the exec Cause function, so you must preserve A6.

To set up the handler, an Interrupt structure must be initialized. This structure is supplied in io_Data of the CD_ADDFRAMEINT command. The handler then gets linked into the handler chain and gets invoked whenever a frame event occurs. You must eventually remove the handler before you exit.

This command only returns when the handler is removed. That is, the device holds onto the IO request until the CD_REMFRAMEINT command is executed with that same IO request. Hence, you must use SendIO() with this command.

NOTES

The interrupt handler can be added before or after a play command is sent. Interrupts will only be generated while CD audio is playing. Interrupts will not be generated when audio is paused.

SEE ALSO

CD_REMFRAMEINT, <devices/cd.h>,<exec/interrupts.h>,exec.library/Cause()

CDATTENUATE

NAME

CD_ATTENUATE -- Attenuate CD audio volume (immediately or gradually)

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_ATTENUATE
io_Data	NULL
io_Length	duration of volume fade in frames
io_Offset	target volume level (0 - 0x7FFF) (-1 = status only)

RESULTS

io_Error	Returns an error if drive does not support attenuation
io_Actual	current volume level (fade may be monitored)

FUNCTION

This command will ramp the CD audio volume up or down from its current value to the value contained in io_Offset. The range is 0 (silence) to 0x7FFF (full volume). If -1 is specified as the target, the attenuation will not be modified; the current attenuation value will be returned in io_Actual.

io_Length contains the duration of the fade. In seconds, this is io_Length divided by the current frame rate (usually 75).

Note that this command returns before the fade has completed. Thus, once started, a fade cannot be aborted. You can, however, send a new CD_ATTENUATE command, which will immediately override any fade currently in progress. An io_Length of zero means attenuate immediately.

If a gradual attenuation command is sent before the play command, the fade will begin as soon as the play command is sent.

NOTES

This command has no effect on Amiga audio volume, only CD audio.

If the drive does not support volume attenuation, but does support mute, a value of under $0800 should be considered mute, and equal to or above should be full volume. If chunky attenuation is supported, the drive should do the best it can. If the drive does not support volume attenuation at all, an error should be returned. Even if only mute is supported, if gradual attenuation is requested, the device should still emulate the fade command and mute based on the $0800 boundary.

CDCHANGENUM

NAME

CD_CHANGENUM -- return the current value of the disk-change counter.

FUNCTION

This command returns the current value of the disk-change counter The disk change counter is incremented each time a disk is inserted or removed from the cd unit.

IO REQUEST INPUT

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_CHANGENUM

IO REQUEST RESULT

io_Error - 0 for success, or an error code as defined in <devices/cd.h>
io_Actual - if io_Error is 0, this contains the current value of the disk-change counter.

CDCHANGESTATE

NAME

CD_CHANGESTATE -- check if a "valid" disk is currently in a drive.

FUNCTION

This command checks to see if there is a "valid" disk in a drive.

IO REQUEST INPUT

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_CHANGESTATE

IO REQUEST RESULT

io_Error - 0 for success, or an error code as defined in <devices/cd.h>
io_Actual - 0 means there is a disk while anything else indicates there is no disk.

NOTES

A "valid" disk is a disk with a readable table of contents.

CDCONFIG

NAME

CD_CONFIG -- Set drive preferences

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_CONFIG
io_Data	pointer to first entry of TagList
io_Length	0

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>

FUNCTION

This command sets one or more of the configuration items. The configuration items are:

TAGCD_PLAYSPEED	Default: 75
TAGCD_READSPEED	Default: 75 (do not ocunt on this)
TAGCD_READXLSPEED	Default: 75
TAGCD_SECTORSIZE	Default: 2048
TAGCD_XLECC	Default: 1 (on)
TAGCD_EJECTRESET	Default: can be 0 (off) or 1 (on)

The speed settings are described in the number of frames (sectors) per second. All CD-ROM drives are capable of the 75 frames/second rate. Some drives are capable of 150 frames/second, and some even more. To determine the maximum frame rate of the drive, use the CD_INFO command. Valid values for caddyless Commodore CD-ROM drives are 75 and 150 (normal speed and double speed). All other values are invalid. You should always make sure the drive is capable of the configuration you are requesting by either using the CD_INFO command, and/or by checking for an error condition after submitting your request.

There are three different types of CD-ROM sectors. Mode 1 sectors (2048 bytes), mode 2 form 1 sectors (2048 bytes), and mode 2 form 2 sectors (2328 bytes). Normally, disks are encoded in Mode 1 format. Mode 2 form 1 is basically the same as mode 1; however, the mode 2 form 2 sector format contains no CD-ROM error correction information. In order to read information encoded in this sector format, the drive's sector size must be configured to 2328 byte sectors.

Error correction (ECC) of the READXL command can be turned off or on with this command. Error correction can be implemented in either hardware or software (depending on the CD-ROM drive). When ECC is implemented in software, CPU

usage can become bursty. Errors rarely occur on CDs unless they have numerous scratches, but when they do occur, they will cause a loss of CPU bandwith. When ECC is implemented in hardware, no CPU bandwidth is lost -- in this case, ECC will always be on no matter how you configure the drive because it is free. The READXL command is used primarily for displaying movie-like data. In this case, speed is essential and data integrety is not; however, if the CPU is not being utilized during an XL animation there is no need to disable ECC (since the bandwidth is there to be used). The only time ECC should be disabled is when you are doing intense calculations in the background of a READXL command, AND your program is time-critical. Do not forget to change this back when you are done!

To make the computer reset when a CD is ejected (for an application that does not exit), use the TAGCD_EJECTRESET tag. When possible, titles should be able to exit cleanly back to Workbench. Error conditions should be monitored when doing disk I/O.

EXAMPLE

```
/* Configure ReadXL for double-speed reading and turn off ECC when */
/* the ReadXL command is used.                                     */

struct TagItem ConfigList[] = {

{ TAGCD_READXLSPEED, 150 },
{ TAGCD_XLECC,       0   },
{ TAG_END,           0   }
};

ior->io_Command = CD_CONFIG;
ior->io_Data    = (APTR)&ConfigList;
ior->io_Length  = 0;
DoIO(ior);

if (ior->io_Error) printf("Could not be configured");
```

NOTES

Setting the configuration will not modify the behavior of a read or play command already in progress.

This can be a very dangerous command. If for instance you set TAGCD_SECTORSIZE to 2328, you will no longer be able to read any data encoded at 2048 byte sectors (e.g. the file system will not be able to read the disk anymore). After you read any data stored with this sector format, you should immediately configure back to the original default value (even if the read failed -- the disk could be removed in the middle of your read). You should NEVER use this command if you are not the exclusive owner of your disk.

BUGS

TAG_IGNORE, TAG_MORE, and TAG_SKIP do not work. Do not use these.

SEE ALSO

CD_INFO, <utility/tagitem.h>

CDEJECT

NAME

CD_EJECT -- Open or close the CD's drive door

IO REQUEST

io_Command	CD_EJECT
io_Data	NULL
io_Length	requested state of drive door (0 == close, 1 == open)
io_Offset	0

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>
io_Actual	previous state of drive door

FUNCTION

This command causes the CD-ROM drive's door to open or close. The desired state of the drive door is placed in io_Length. The previous state of the drive door is returned in io_Actual.

CDGETGEOMETRY

NAME

CD_GETGEOMETRY -- return the geometry of the drive.

FUNCTION

This command returns a full set of information about the layout of the drive. The information is returned in the DriveGeometry structure pointed to by io_Data.

IO REQUEST INPUT

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_GETGEOMETRY
io_Data	pointer to a DriveGeometry structure
io_Length	sizeof(struct DriveGeometry)

IO REQUEST RESULT

io_Error - 0 for success, or an error code as defined in <devices/cd.h>
io_Actual - length of data transferred.

SEE ALSO

CD_GETNUMTRACKS, <devices/trackdisk.h>

CDINFO

NAME

CD_INFO -- Return information/status of device

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_INFO
io_Data	pointer to CDInfo structure
io_Length	sizeof(struct CDInfo)

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>
io_Actual	length of data transferred

FUNCTION

This command returns current configurations and status of the device driver.

EXAMPLE

```
struct CDInfo Info;

ior->io_Command = CD_INFO;             /* Retrieve drive info.    */
ior->io_Data    = (APTR)Info;          /* Here's where we want it */
ior->io_Length  = sizeof(struct CDInfo);/* Return whole structure  */
DoIO(ior);

if (!ior->io_Error) {                  /* Command succeeded       */

if (Info.Status & CDSTSF_PLAYING) printf("Audio is playing");
else                              printf("Audio not playing");
}
```

SEE ALSO

<devices/cd.h>

CDMOTOR

NAME

CD_MOTOR -- control the on/off state of a drive motor.

FUNCTION

This command gives control over the spindle motor. The motor may be turned on or off.

If the motor is just being turned on, the device will delay the proper amount of time to allow the drive to come up to speed. Turning the motor on or off manually

is not necessary, the device does this automatically if it receives a request when the motor is off.

IO REQUEST INPUT

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_MOTOR
io_Length	the requested state of the motor, 0 to turn the motor off, and 1 to turn the motor on.

IO REQUEST RESULT

io_Error - 0 for success, or an error code as defined in <devices/cd.h>
io_Actual - if io_Error is 0 this contains the previous state of the drive motor.

CDPAUSE

NAME

CD_PAUSE -- Pause or unPause play command.

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_PAUSE
io_Data	NULL
io_Length	pausemode : 1 = pause play; 0 = do not pause play;
io_Offset	0

RESULTS

io_Actual - if io_Error is 0, this contains the previous pause state.

FUNCTION

This command will place the CD in, or take the CD out of pause mode. The desired pause state is placed in io_Length. This command only effects play commands. When the audio is playing and the pausemode is set, this command will immediately pause the audio output suspending the play command until the play is unpaused. When audio is not playing and the pausemode is set, this command will set the pause mode (having no immediate effect). When a play command is submitted, the laser will seek to the appropriate position and pause at that spot. The play command will be suspended until the play is unpaused (or the play is aborted).

CDPLAYLSN

NAME

CD_PLAYLSN -- Play a selected portion of CD audio (LSN form).

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_PLAYLSN
io_Data	NULL
io_Length	length of play
io_Offset	starting position

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>

FUNCTION

This command causes the drive to start playing CD audio from the specified position until the specified length has passed.

io_Offset specifies the starting position. io_Length contains the amount of time to play. All data is specified in LSN format.

A DoIO() will not return until the requested number of sectors have been played. A SendIO() will return as soon as the PLAY has been started. At this time other commands can be sent (like CD_PAUSE). To stop a play before the specified length has been reached, use AbortIO().

EXAMPLE

```
/* Play two minutes, ten seconds of audio starting at 20 minutes, */
/* 58 seconds, and 10 frames.                                     */

ior->io_Command = CD_PLAYLSN;   /* Play CD audio           */
ior->io_Offset  = 94360;        /* 20*(60*75) + 58*75 + 10 */
ior->io_Length  = 9750;         /* 02*(60*75) + 10*75 + 00 */
DoIO (ior);
```

SEE ALSO

CD_PLAYTRACK, CD_PAUSE, CD_SEARCH, CD_ATTENUATE

CDPLAYMSF

NAME

CD_PLAYMSF -- Play a selected portion of CD audio (MSF form).

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_PLAYMSF
io_Data	NULL
io_Length	length of play
io_Offset	starting position

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>

FUNCTION

This command causes the drive to start playing CD audio from the specified position until the specified length has passed.

io_Offset specifies the starting position. io_Length contains the amount of time to play. All data is specified in MSF format.

A DoIO() will not return until the requested number of sectors have been played. A SendIO() will return as soon as the PLAY has been started. At this time other commands can be sent (like CD_PAUSE). To stop a play before the specified length has been reached, use AbortIO().

EXAMPLE

```
/* Play two minutes, ten seconds of audio starting at 20 minutes, */
/* 58 seconds, and 10 frames.                                     */

ior->io_Command = CD_PLAYMSF;   /* Play CD audio           */
ior->io_Offset  = 0x00143A0A;   /* $14=20, $3A=58, $0A=10 */
ior->io_Length  = 0x00020A00;   /* $02=02, $0A=10, $00=00 */
DoIO (ior);
```

SEE ALSO

CD_PLAYTRACK, CD_PAUSE, CD_SEARCH, CD_ATTENUATE

CDPLAYTRACK

NAME
CD_PLAYTRACK -- Play one or more tracks of CD audio.

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_PLAYTRACK
io_Data	NULL
io_Length	number of tracks to play
io_Offset	start playing at beginning of this track

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>

FUNCTION
This command causes the drive to play the specified audio track(s). The command will return when the audio has completed.

io_Offset specifies the track number (starting from 1).

io_Length specifies the number of tracks to play (0 is invalid).

EXAMPLE
```
ior->io_Command = CD_PLAYTRACK;     /* Play audio tracks     */
ior->io_Offset  = STARTTRACK;       /* Start with this track */
ior->io_Length  = 3;                /* Play three tracks     */
DoIO(ior);
```

NOTES
PLAY commands are asynchronous with many other CD commands. Using a separate I/O request, other commands can be sent to the device that can change the behavior of the PLAY command.

SEE ALSO
CD_PLAYMSF, CD_PLAYLSN, CD_PAUSE, CD_SEARCH, CD_ATTENUATE

CDPROTSTATUS

NAME
CD_PROTSTATUS -- return whether the current disk is write-protected.

FUNCTION
This command is used to determine whether the current disk is write-protected. Currently, this function always returns write- protected status. If write-once CDs are made available at some point, this may change.

IO REQUEST INPUT

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_PROTSTATUS

IO REQUEST RESULT
io_Error - 0 for success, or an error code as defined in <devices/cd.h>
io_Actual - 0 means the disk is NOT write-protected, while any other value indicates it is.

CDQCODELSN

NAME
CD_QCODELSN -- Report current disk position.

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_QCODELSN
io_Data	pointer to QCode structure
io_Length	0 - MUST be zero (for future compatability)

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>

FUNCTION
This command reports current subcode Q channel time information. This command only returns data when CD Audio is playing (or paused). At any other time, an error is returned. The Q-Code packet consists of:

```
struct QCode {

UBYTE        CtlAdr;        /* Data type / QCode type           */
UBYTE        Track;         /* Track number                     */
UBYTE        Index;         /* Track subindex number            */
UBYTE        Zero;          /* The "Zero" byte of Q-Code packet */
union LSNMSF TrackPosition; /* Position from start of track     */
union LSNMSF DiskPosition;  /* Position from start of disk      */
};
```

EXAMPLE

```
struct QCode qcode;

ior->io_Command = CD_QCODELSN;  /* Retrieve TOC information */
ior->io_Length  = 0;            /* MUST be zero             */
ior->io_Data    = (APTR)qcode;  /* Here's where we want it  */
DoIO (ior);

if (!ior->io_Error) {           /* Command succeeded        */

printf("Current position is: %ld", qcode.DiskPosition.LSN);
}
```

NOTES

This function may not return immediately. It may take several frames to pass by before a valid Q-Code packet can be returned. Use SendIO() and CheckIO() if response time is critical, and the information is not.

SEE ALSO

CD_PLAYMSF, CD_PLAYLSN, CD_PLAYTRACK, <devices/cd.h>

CDQCODEMSF

NAME

CD_QCODEMSF -- Report current disk position.

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_QCODEMSF
io_Data	pointer to QCode structure
io_Length	0 - MUST be zero (for future compatability)

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>

FUNCTION

This command reports current subcode Q channel time information. This command only returns data when CD Audio is playing (or paused). At any other time, an error is returned. The Q-Code packet consists of:

cd.device

```
struct QCode {

UBYTE        CtlAdr;        /* Data type / QCode type           */
UBYTE        Track;         /* Track number                     */
UBYTE        Index;         /* Track subindex number            */
UBYTE        Zero;          /* The "Zero" byte of Q-Code packet */
union LSNMSF TrackPosition; /* Position from start of track     */
union LSNMSF DiskPosition;  /* Position from start of disk      */
};
```

EXAMPLE

```
struct QCode qcode;

ior->io_Command = CD_QCODEMSF;  /* Retrieve TOC information */
ior->io_Length  = 0;            /* MUST be zero             */
ior->io_Data    = (APTR)qcode;  /* Here's where we want it  */
DoIO (ior);

if (!ior->io_Error) {           /* Command succeeded        */

printf("Current position is: %02d:%02d:%02d",
qcode.DiskPosition.MSF.Minute,
qcode.DiskPosition.MSF.Second,
qcode.DiskPosition.MSF.Frame);
}
```

NOTES

This function may not return immediately. It may take several frames to pass by before a valid Q-Code packet can be returned. Use SendIO() and CheckIO() if response time is critical, and the information is not.

SEE ALSO

CD_PLAYMSF, CD_PLAYLSN, CD_PLAYTRACK, <devices/cd.h>

CDREAD

NAME

CD_READ -- read data from disk.

FUNCTION

Reads data from the CD into memory. Data may be accessed on WORD boundaries (you are not restricted to sector boundaries as with normal disk devices). Data lengths can also be described in WORD amounts.

IO REQUEST INPUT

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_READ
io_Data	pointer to the buffer where the data should be put
io_Length	number of bytes to read, must be a WORD multiple.
io_Offset	byte offset from the start of the disk describing where to read data from, must be a WORD multiple.

IO REQUEST RESULT

io_Error - 0 for success, or an error code as defined in <devices/cd.h>
io_Actual - if io_Error is 0, number of bytes actually transferred

SEE ALSO

CD_READXL

CDREADXL

NAME

CD_READXL -- Read from CD-ROM into memory via transfer list.

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_READXL
io_Data	pointer to transfer list (i.e. struct List *).
io_Length	maximum transfer length (WORD multiple) or 0.
io_Offset	byte offset from the start of the disk describing where to read data from, must be a WORD multiple.

RESULTS

io_Error	0 for success, or an error code as described in <devices/cd.h>
io_Actual	if io_Error is 0, number of bytes actually transferred

FUNCTION

This command starts reading data off the disk at the specified location and deposits it into memory according to the nodes in a transfer list. The pointer to the list of transfer nodes is placed in io_Data. If you have a non-circular transfer list, simply set io_Length to 0 (0 is special and means ignore io_Length) -- your transfer will end when your transfer list has been exhausted. If you have a circular transfer list, the list will never end. In this case, the transfer will terminate when io_Length bytes have been transferred.

The fields in the CDXL node structure are:

```
struct  CDXL {

struct MinNode  Node;         /* double linkage                */
char           *Buffer;       /* data destination              */
LONG            Length;       /* must be even # bytes          */
LONG            Actual;       /* bytes transferred             */
APTR            IntData;      /* interrupt server data segment */
VOID            (*IntCode)(); /* interrupt server code entry   */
};
```

The philosophy here is that you set up the buffers you want filled, create CDXL nodes describing the locations and sizes of these buffers, link all the nodes together in the order that you'd like (even make a circular list for animations), and

execute the command. The data will be streamed into the appropriate buffers until the list has been exhausted, an entry with a Length of zero is encountered, io_Length bytes have been transferred (if io_Length is non-zero), or the command is aborted with AbortIO().

If you fill in the (*IntCode)() field with a pointer to an interrupt routine, your routine will be called when the transfer for the node is complete. Your code will be called before the driver proceeds to the next node. The interrupt should follow the same rules as standard interrupts (see AddIntServer of Exec autodocs). Register A2 will contain a pointer to the node just completed. You may manipulate the list from within the interrupt. Your code must be brief (this is an interrupt). When returning from this interrupt, D0 should be cleared and an RTS instruction should be used to return.

Servers are called with the following register conventions:

D0 - scratch
D1 - scratch

A0 - scratch
A1 - server is_Data pointer (scratch)
A2 - pointer to CDXL node just completed

A5 - jump vector register (scratch)

all other registers must be preserved

NOTES

Try to make sure that small buffers are not overused. Each time a node is completed, an interrupt is generated. If you find that your computer is acting sluggish, or the CD_READXL command is aborting, you are probably generating too many interrupts. It is not efficient to have more than a few of these interrupts generated within a vertical blank.

Unlike the READ command, the READXL command will not retry a sector if there is an error. Since the READXL command's purpose is primarily for animations, data streaming is considered more important than the data itself. An error will be returned in io_Error if a data error did occur. This command will never drop to a lower speed in the event of an error.

SEE ALSO

CMD_READ, CD_SEEK, Autodocs - AddIntServer

CDREMCHANGEINT

NAME
CD_REMCHANGEINT -- remove a disk change software interrupt handler.

FUNCTION
This command removes a disk change software interrupt added by a previous use of CD_ADDCHANGEINT.

IO REQUEST INPUT
The same IO request used for CD_ADDCHANGEINT.

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_REMCHANGEINT
io_Length	sizeof(struct Interrupt)
io_Data	pointer to Interrupt structure

IO REQUEST RESULT
io_Error - 0 for success, or an error code as defined in <devices/cd.h>

SEE ALSO
CD_ADDCHANGEINT, <devices/cd.h>

CDREMFRAMEINT

NAME
CD_REMFRAMEINT -- remove a CD-frame interrupt handler.

IO REQUEST
The same IO request used for CD_ADDFRAMEINT.

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_REMFRAMEINT
io_Length	sizeof(struct Interrupt)
io_Data	pointer to Interrupt structure

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>

FUNCTION
This command removes a CD-frame software interrupt added by a previous use of CD_ADDFRAMEINT.

SEE ALSO
CD_ADDFRAMEINT, <devices/cd.h>

CDSEARCH

NAME
CD_SEARCH -- configure the mode in which PLAY commands play

IO REQUEST

io_Command	CD_SEARCH
io_Data	NULL
io_Length	searchmode
io_Offset	0

RESULTS
io_Actual - if io_Error is 0, this contains the previous search mode.

FUNCTION
This command causes a play command to play in fast-forward, fast-reverse, or normal play mode. These modes are defined as:

CDMODE_NORMAL	0	Normal play (current speed setting)
CDMODE_FFWD	1	Play in fast forward mode
CDMODE_FREV	2	Play in fast reverse mode

The search mode can be set before the play command is sent, or during a play. If CD_SEARCH is sent before a play command is sent, the mode is set and the command immediately returns. If the mode is set to REV mode, when the play command is sent the play will begin at the requested end position and work backwards to the start position.

If CD_SEARCH is sent during a play, the play will automatically switch to the desired mode and continue playing until the original play command is completed. If REV mode is set and the beginning of the play is encountered before switching back to forward play, the play command will terminate with no error.

EXAMPLE

```
/* Search in fast forward mode. */
ior->io_Command = CD_SEARCH;
ior->io_Data    = NULL;
ior->io_Offset  = 0;
ior->io_Length  = CDMODE_FFWD;
DoIO(ior);
```

CDSEEK

NAME

CD_SEEK -- position laser at specified location.

FUNCTION

CD_SEEK moves the laser to the approximate position specified. The io_Offset field should be set to the offset to which the head is to be positioned.

IO REQUEST INPUT

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_SEEK
io_Offset	position where head is to be moved (always LSN format)

IO REQUEST RESULT

io_Error - 0 for success, or an error code as defined in <devices/cd.h>

CDTOCLSN

NAME

CD_TOCLSN -- Return table of contents information from CD (LSN form).

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_TOCLSN
io_Data	pointer to array where TOC is to be stored
io_Length	number of CDTOC entries to be fetched
io_Offset	entry to begin at (entry 0 is summary information)

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>
io_Actual	Actual number of entries copied

FUNCTION

This command returns the table of contents of the disk currently in the drive. The table of contents consists of up to 100 entries. Entry zero is summary information describing the number of tracks and the total number of minutes on the disk. Entries 1 through N contain information about each individual track. All position information will be in LSN format.

The io_Data field points to an array of CDTOC structures to receive the TOC data.

The io_Length field specifies the total number of entries to be fetched. The array pointed to by io_Data must be at least this many elements in size.

The io_Offset field specifies the entry number at which to start copying TOC data into *io_Data.

Entry zero (the summary entry) contains the following:

```
struct TOCSummary {

UBYTE        FirstTrack;    /* First track on disk (always 1)   */
UBYTE        LastTrack;     /* Last track on disk               */
union LSNMSF LeadOut;       /* Beginning of lead-out track      */
};
```

Track entries (entries 1 through number of tracks) contain:

```
struct TOCEntry {

UBYTE        CtlAdr;        /* Q-Code info                  */
UBYTE        Track;         /* Track number                 */
union LSNMSF Position;      /* Start position of this track */
};
```

CDTOC is described as a union between these two structures:

```
union CDTOC {

struct TOCSummary Summary;  /* First entry is summary info.  */
struct TOCEntry   Entry;    /* Entries 1-N are track entries */
};
```

EXAMPLE

```
union CDTOC tocarray[100];

ior->io_Command = CD_TOCLSN;        /* Retrieve TOC information */
ior->io_Offset  = 0;                /* Start with summary info  */
ior->io_Length  = 100;              /* Max 99 tracks + summary  */
ior->io_Data    = (APTR)tocarray;   /* Here's where we want it  */
DoIO (ior);

if (!ior->io_Error) {               /* Command succeeded        */

firsttrack   = tocarray[0].Summary.FirstTrack;
lasttrack    = tocarray[0].Summary.LastTrack;
totalsectors = tocarray[0].Summary.LeadOut.LSN -
tocarray[1].Entry.Position.LSN;
}
```

NOTES

In the above example, the amount of data on the disk is calculated as being equal to the location of the lead-out track minus the start of the first track (which is never zero).

CDTOCMSF

NAME

CD_TOCMSF -- Return table of contents information from CD (MSF form).

IO REQUEST

io_Device	preset by the call to OpenDevice()
io_Unit	preset by the call to OpenDevice()
io_Command	CD_TOCMSF
io_Data	pointer to array where TOC is to be stored
io_Length	number of CDTOC entries to be fetched
io_Offset	entry to begin at (entry 0 is summary information)

RESULTS

io_Error	0 for success, or an error code as defined in <devices/cd.h>
io_Actual	Actual number of entries copied

FUNCTION

This command returns the table of contents of the disk currently in the drive. The table of contents consists of up to 100 entries. Entry zero is summary information describing the number of tracks and the total number of minutes on the disk. Entries 1 through N contain information about each individual track. All position information will be in MSF format.

The io_Data field points to an array of CDTOC structures to receive the TOC data.

The io_Length field specifies the total number of entries to be fetched. The array pointed to by io_Data must be at least this many elements in size.

The io_Offset field specifies the entry number at which to start copying TOC data into *io_Data.

Entry zero (the summary entry) contains the following:

```
struct TOCSummary {

UBYTE        FirstTrack;    /* First track on disk (always 1)   */
UBYTE        LastTrack;     /* Last track on disk               */
union LSNMSF LeadOut;       /* Beginning of lead-out track      */
};
```

Track entries (entries 1 through number of tracks) contain:

```
struct TOCEntry {

UBYTE        CtlAdr;        /* Q-Code info                  */
UBYTE        Track;         /* Track number                 */
union LSNMSF Position;      /* Start position of this track */
};
```


CDTOC is described as a union between these two structures:

```
union CDTOC {

struct TOCSummary Summary;  /* First entry is summary info.  */
struct TOCEntry   Entry;    /* Entries 1-N are track entries */
};
```

CloseDevice

NAME

CloseDevice - terminate access to the CD

SYNOPSIS

CloseDevice(IORequest);
A1

FUNCTION

This function will terminate access to the unit openned with OpenDevice().

INPUTS

iORequest - pointer to a struct(IOStdReq)

SEE ALSO

OpenDevice()

OpenDevice

NAME

OpenDevice - Open a CD unit for access

SYNOPSIS

error = OpenDevice("cd.device", UnitNumber, IORequest, flags);
D0 A0 D0 A1 D1

FUNCTION

Opens the cd.device and creates an IORequest for use in accessing the CD.

INPUTS

UnitNumber - Normally zero; however, this is described as:
Ones digit = Unit (SCSI unit number)
Tens digit = LUN (disk within disk changer)

Hundreds digit = Card number (SCSI card)
Thousands digit = Reserved (must be zero)

IORequest - Pointer to a struct(IOStdReq)
flags - Should be zero.

RESULTS

error 0 = success, otherwise this is an error.

SEE ALSO

CloseDevice()

cd.device

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INCLUDES

devices/cd.h

```
#ifndef CD_H
#define CD_H

/*****************************************************************************
*                                                                            *
*   CD Commands                                                              *
*                                                                            *
*****************************************************************************/

#define CD_RESET            1
#define CD_READ             2
#define CD_WRITE            3
#define CD_UPDATE           4
#define CD_CLEAR            5
#define CD_STOP             6
#define CD_START            7
#define CD_FLUSH            8
#define CD_MOTOR            9
#define CD_SEEK            10
#define CD_FORMAT          11
#define CD_REMOVE          12
#define CD_CHANGENUM       13
#define CD_CHANGESTATE     14
#define CD_PROTSTATUS      15

#define CD_GETDRIVETYPE    18
#define CD_GETNUMTRACKS    19
#define CD_ADDCHANGEINT    20
#define CD_REMCHANGEINT    21
#define CD_GETGEOMETRY     22
#define CD_EJECT           23


#define CD_INFO            32
#define CD_CONFIG          33
#define CD_TOCMSF          34
#define CD_TOCLSN          35

#define CD_READXL          36

#define CD_PLAYTRACK       37
#define CD_PLAYMSF         38
#define CD_PLAYLSN         39
#define CD_PAUSE           40
#define CD_SEARCH          41

#define CD_QCODEMSF        42
#define CD_QCODELSN        43
#define CD_ATTENUATE       44

#define CD_ADDFRAMEINT     45
#define CD_REMFRAMEINT     46


/*****************************************************************************
*                                                                            *
*   Device Driver Error Codes                                                *
*                                                                            *
*****************************************************************************/

#define CDERR_OPENFAIL       (-1) /* device/unit failed to open           */
#define CDERR_ABORTED        (-2) /* request terminated early             */
#define CDERR_NOCMD          (-3) /* command not supported by device      */
#define CDERR_BADLENGTH      (-4) /* invalid length (IO_LENGTH/IO_OFFSET) */
#define CDERR_BADADDRESS     (-5) /* invalid address (IO_DATA misaligned) */
#define CDERR_UNITBUSY       (-6) /* device opens ok, but unit is busy    */
#define CDERR_SELFTEST       (-7) /* hardware failed self-test            */

#define CDERR_NotSpecified   20   /* general catchall                     */
#define CDERR_NoSecHdr       21   /* couldn't even find a sector          */
#define CDERR_BadSecPreamble 22   /* sector looked wrong                  */
#define CDERR_BadSecID       23   /* ditto                                */
```

```
#define CDERR_BadHdrSum      24   /* header had incorrect checksum        */
#define CDERR_BadSecSum      25   /* data had incorrect checksum          */
#define CDERR_TooFewSecs     26   /* couldn't find enough sectors         */
#define CDERR_BadSecHdr      27   /* another "sector looked wrong"        */
#define CDERR_WriteProt      28   /* can't write to a protected disk      */
#define CDERR_NoDisk         29   /* no disk in the drive                 */
#define CDERR_SeekError      30   /* couldn't find track 0                */
#define CDERR_NoMem          31   /* ran out of memory                    */
#define CDERR_BadUnitNum     32   /* asked for a unit > NUMUNITS          */
#define CDERR_BadDriveType   33   /* not a drive cd.device understands    */
#define CDERR_DriveInUse     34   /* someone else allocated the drive     */
#define CDERR_PostReset      35   /* user hit reset; awaiting doom        */
#define CDERR_BadDataType    36   /* data on disk is wrong type           */
#define CDERR_InvalidState   37   /* invalid cmd under current conditions */

#define CDERR_Phase          42   /* illegal or unexpected SCSI phase     */
#define CDERR_NoBoard        50   /* open failed for non-existant board   */


/*****************************************************************************
*                                                                            *
* Configuration                                                              *
*                                                                            *
*       The drive is configured by TagList items defined as follows:         *
*                                                                            *
*****************************************************************************/

#define TAGCD_PLAYSPEED         0x0001
#define TAGCD_READSPEED         0x0002
#define TAGCD_READXLSPEED       0x0003
#define TAGCD_SECTORSIZE        0x0004
#define TAGCD_XLECC             0x0005
#define TAGCD_EJECTRESET        0x0006

/*****************************************************************************
*                                                                            *
* Information                                                                *
*                                                                            *
*      Information/Status structure describes current speed settings         *
*      for read and play commands, sector size, audio attenuation            *
*      precision, and drive status.                                          *
*                                                                            *
*****************************************************************************/

struct CDInfo {
                        /*                                  Default     */
    UWORD   PlaySpeed;      /* Audio play speed             (75)        */
    UWORD   ReadSpeed;      /* Data-rate of CD_READ command (Max)       */
    UWORD   ReadXLSpeed;    /* Data-rate of CD_READXL command (75)      */
    UWORD   SectorSize;     /* Number of bytes per sector   (2048)      */
    UWORD   XLECC;          /* CDXL ECC enabled/disabled                */
    UWORD   EjectReset;     /* Reset on eject enabled/disabled          */
    UWORD   Reserved1[4];   /* Reserved for future expansion            */

    UWORD   MaxSpeed;       /* Maximum speed drive can handle (75, 150) */
    UWORD   AudioPrecision; /* 0 = no attenuator, 1 = mute only,        */
    /* other = (# levels - 1)           */
    UWORD   Status;         /* See flags below                          */
    UWORD   Reserved2[4];   /* Reserved for future expansion            */
};


/* Flags for Status */

#define CDSTSB_CLOSED    0 /* Drive door is closed                      */
#define CDSTSB_DISK      1 /* A disk has been detected                  */
#define CDSTSB_SPIN      2 /* Disk is spinning (motor is on)            */
#define CDSTSB_TOC       3 /* Table of contents read.  Disk is valid.   */
#define CDSTSB_CDROM     4 /* Track 1 contains CD-ROM data              */
#define CDSTSB_PLAYING   5 /* Audio is playing                          */
#define CDSTSB_PAUSED    6 /* Pause mode (pauses on play command)       */
#define CDSTSB_SEARCH    7 /* Search mode (Fast Forward/Fast Reverse)   */
#define CDSTSB_DIRECTION 8 /* Search direction (0 = Forward, 1 = Reverse) */
```



```
#define CDSTSF_CLOSED    0x0001
#define CDSTSF_DISK      0x0002
#define CDSTSF_SPIN      0x0004
#define CDSTSF_TOC       0x0008
#define CDSTSF_CDROM     0x0010
#define CDSTSF_PLAYING   0x0020
#define CDSTSF_PAUSED    0x0040
#define CDSTSF_SEARCH    0x0080
#define CDSTSF_DIRECTION 0x0100


/* Modes for CD_SEARCH */

#define CDMODE_NORMAL   0         /* Normal play at current play speed    */
#define CDMODE_FFWD     1         /* Fast forward play (skip-play forward)*/
#define CDMODE_FREV     2         /* Fast reverse play (skip-play reverse)*/


/*****************************************************************************
*                                                                            *
* Position Information                                                       *
*                                                                            *
*      Position information can be described in two forms: MSF and LSN       *
*      form.  MSF (Minutes, Seconds, Frames) form is a time encoding.        *
*      LSN (Logical Sector Number) form is frame (sector) count.             *
*      The desired form is selected using the io_Flags field of the          *
*      IOStdReq structure.  The flags and the union are described            *
*      below.                                                                *
*                                                                            *
*****************************************************************************/

struct RMSF {

    UBYTE   Reserved;       /* Reserved (always zero) */
    UBYTE   Minute;         /* Minutes (0-72ish)      */
    UBYTE   Second;         /* Seconds (0-59)         */
    UBYTE   Frame;          /* Frame   (0-74)         */
};

union LSNMSF {

    struct  RMSF MSF;       /* Minute, Second, Frame  */
    ULONG   LSN;            /* Logical Sector Number  */
};


/*****************************************************************************
*                                                                            *
* CD Transfer Lists                                                          *
*                                                                            *
*      A CDXL node is a double link node; however only single linkage        *
*      is used by the device driver.  If you wish to construct a             *
*      transfer list manually, it is only neccessary to define the           *
*      mln_Succ pointer of the MinNode.  You may also use the Exec           *
*      list functions by defining a List or MinList structure and by         *
*      using the AddHead/AddTail functions to create the list.  This         *
*      will create a double-linked list.  Although a double-linked           *
*      list is not required by the device driver, you may wish use it        *
*      for your own purposes.  Don't forget to initialize the                *
*      the List/MinList before using it!                                     *
*                                                                            *
*****************************************************************************/

struct  CDXL {

    struct MinNode    Node;           /* double linkage                 */
    char             *Buffer;         /* data destination (word aligned) */
    LONG              Length;         /* must be even # bytes           */
    LONG              Actual;         /* bytes transferred              */
    APTR              IntData;        /* interrupt server data segment  */
    VOID              (*IntCode)();   /* interrupt server code entry    */
};
```

devices/cd.h

```
/************************************************************************
*                                                                       *
* CD Table of Contents                                                  *
*                                                                       *
*      The CD_TOC command returns an array of CDTOC entries.            *
*      Entry zero contains summary information describing how many      *
*      tracks the disk has and the play-time of the disk.               *
*      Entries 1 through N (N = Number of tracks on disk) contain       *
*      information about the track.                                     *
*                                                                       *
************************************************************************/

struct TOCSummary {

    UBYTE        FirstTrack; /* First track on disk (always 1)           */
    UBYTE        LastTrack;  /* Last track on disk                       */
    union LSNMSF LeadOut;    /* Beginning of lead-out track (end of disk) */
};


struct TOCEntry {

    UBYTE        CtlAdr;     /* Q-Code info                 */
    UBYTE        Track;      /* Track number                */
    union LSNMSF Position;   /* Start position of this track */
};


union CDTOC {

    struct TOCSummary Summary;  /* First entry (0) is summary information */
    struct TOCEntry   Entry;    /* Entries 1-N are track entries          */
};



/************************************************************************
*                                                                       *
* Q-Code Packets                                                        *
*                                                                       *
*      Q-Code packets are only returned when audio is playing.          *
*      Currently, only position packets are returned (ADR_POSITION)     *
*      The other ADR_ types are almost never encoded on the disk        *
*      and are of little use anyway.  To avoid making the QCode         *
*      structure a union, these other ADR_ structures are not defined.  *
*                                                                       *
************************************************************************/

struct QCode {

    UBYTE        CtlAdr;        /* Data type / QCode type           */
    UBYTE        Track;         /* Track number                     */
    UBYTE        Index;         /* Track subindex number            */
    UBYTE        Zero;          /* The "Zero" byte of Q-Code packet */
    union LSNMSF TrackPosition; /* Position from start of track     */
    union LSNMSF DiskPosition;  /* Position from start of disk      */
};


#define CTLADR_CTLMASK 0xF0   /* Control field */

#define CTL_CTLMASK    0xD0   /* To be ANDed with CtlAdr before compared  */

#define CTL_2AUD       0x00   /* 2 audio channels without preemphasis     */
#define CTL_2AUDEMPH   0x10   /* 2 audio channels with preemphasis        */
#define CTL_4AUD       0x80   /* 4 audio channels without preemphasis     */
#define CTL_4AUDEMPH   0x90   /* 4 audio channels with preemphasis        */
#define CTL_DATA       0x40   /* CD-ROM Data                              */

#define CTL_COPYMASK   0x20   /* To be ANDed with CtlAdr before compared  */
```


devices/cd.h

```
#define CTL_COPY       0x20   /* When true, this audio/data can be copied */

#define CTLADR_ADRMASK 0x0F   /* Address field                            */

#define ADR_POSITION   0x01   /* Q-Code is position information           */
#define ADR_UPC        0x02   /* Q-Code is UPC information (not used)     */
#define ADR_ISRC       0x03   /* Q-Code is ISRC (not used)                */
#define ADR_HYBRID     0x05   /* This disk is a hybrid disk               */


#endif
```

```
        IFND    CD_I
CD_I    SET     1

INCLUDE "include:utility/tagitem.i"

*****************************************************************************
*                                                                           *
*   CD Commands                                                             *
*                                                                           *
*****************************************************************************

CD_RESET            equ  1
CD_READ             equ  2
CD_WRITE            equ  3
CD_UPDATE           equ  4
CD_CLEAR            equ  5
CD_STOP             equ  6
CD_START            equ  7
CD_FLUSH            equ  8
CD_MOTOR            equ  9
CD_SEEK             equ 10
CD_FORMAT           equ 11
CD_REMOVE           equ 12
CD_CHANGENUM        equ 13
CD_CHANGESTATE      equ 14
CD_PROTSTATUS       equ 15

CD_GETDRIVETYPE     equ 18
CD_GETNUMTRACKS     equ 19
CD_ADDCHANGEINT     equ 20
CD_REMCHANGEINT     equ 21
CD_GETGEOMETRY      equ 22
CD_EJECT            equ 23

CD_INFO             equ 32
CD_CONFIG           equ 33
CD_TOCMSF           equ 34
CD_TOCLSN           equ 35

CD_READXL           equ 36

CD_PLAYTRACK        equ 37
CD_PLAYMSF          equ 38
CD_PLAYLSN          equ 39
CD_PAUSE            equ 40
CD_SEARCH           equ 41

CD_QCODEMSF         equ 42
CD_QCODELSN         equ 43
CD_ATTENUATE        equ 44

CD_ADDFRAMEINT      equ 45
CD_REMFRAMEINT      equ 46

*
*****************************************************************************
*                                                                           *
*   Device Driver Error Codes                                               *
*                                                                           *
*****************************************************************************

CDERR_OPENFAIL          equ -1      ; device/unit failed to open
CDERR_ABORTED           equ -2      ; request terminated early
CDERR_NOCMD             equ -3      ; command not supported by device
CDERR_BADLENGTH         equ -4      ; invalid length (IO_LENGTH/IO_OFFSET)
CDERR_BADADDRESS        equ -5      ; invalid address (IO_DATA misaligned)
CDERR_UNITBUSY          equ -6      ; device opens ok, but unit is busy
CDERR_SELFTEST          equ -7      ; hardware failed self-test

CDERR_NotSpecified      equ 20      ; general catchall
CDERR_NoSecHdr          equ 21      ; couldn't even find a sector
CDERR_BadSecPreamble    equ 22      ; sector looked wrong
```



```
CDERR_BadSecID          equ 23      ; ditto
CDERR_BadHdrSum         equ 24      ; header had incorrect checksum
CDERR_BadSecSum         equ 25      ; data had incorrect checksum
CDERR_TooFewSecs        equ 26      ; couldn't find enough sectors
CDERR_BadSecHdr         equ 27      ; another "sector looked wrong"
CDERR_WriteProt         equ 28      ; can't write to a protected disk
CDERR_NoDisk            equ 29      ; no disk in the drive
CDERR_SeekError         equ 30      ; couldn't find track 0
CDERR_NoMem             equ 31      ; ran out of memory
CDERR_BadUnitNum        equ 32      ; asked for a unit > NUMUNITS
CDERR_BadDriveType      equ 33      ; not a drive cd.device understands
CDERR_DriveInUse        equ 34      ; someone else allocated the drive
CDERR_PostReset         equ 35      ; user hit reset; awaiting doom
CDERR_BadDataType       equ 36      ; data on disk is wrong type
CDERR_InvalidState      equ 37      ; invalid cmd under current conditions

CDERR_Phase             equ 42      ; illegal or unexpected SCSI phase
CDERR_NoBoard           equ 50      ; open failed for non-existant board


*****************************************************************************
*                                                                           *
* Configuration                                                             *
*                                                                           *
*       The drive is configured by TagList items defined as follows:        *
*                                                                           *
*****************************************************************************

TAGCD_PLAYSPEED         equ     $0001
TAGCD_READSPEED         equ     $0002
TAGCD_READXLSPEED       equ     $0003
TAGCD_SECTORSIZE        equ     $0004
TAGCD_XLECC             equ     $0005
TAGCD_EJECTRESET        equ     $0006

*
*****************************************************************************
*                                                                           *
* Information                                                               *
*                                                                           *
*      Information/Status structure describes current speed settings        *
*      for read and play commands, sector size, audio attenuation           *
*      precision, and drive status.                                         *
*                                                                           *
*****************************************************************************

STRUCTURE CDINFO,0
                                    ;                                   Default
    UWORD  CDINFO_PlaySpeed         ; Audio play speed                  (75)
    UWORD  CDINFO_ReadSpeed         ; Data-rate of CD_READ command      (Max)
    UWORD  CDINFO_ReadXLSpeed       ; Data-rate of CD_READXL command    (75)
    UWORD  CDINFO_SectorSize        ; Number of bytes per sector        (2048)
    UWORD  CDINFO_XLECC             ; CDXL ECC enabled/disabled
    UWORD  CDINFO_EjectReset        ; Reset on eject enabled/disabled
    STRUCT CDINFO_Reserved1,8       ; Reserved for future expansion

    UWORD  CDINFO_MaxSpeed          ; Maximum speed drive can handle (75, 150)
    UWORD  CDINFO_AudioPrecision    ; 0 = no attenuator, 1 = mute only,
    ; other = (# levels - 1)
    UWORD  CDINFO_Status            ; See flags below
    STRUCT CDINFO_Reserved2,8       ; Reserved for future expansion

    LABEL  CDINFO_SIZE


; Flags for Status

CDSTSB_CLOSED       equ 0       ; Drive door is closed
CDSTSB_DISK         equ 1       ; A disk has been detected
CDSTSB_SPIN         equ 2       ; Disk is spinning (motor is on)
CDSTSB_TOC          equ 3       ; Table of contents read.  Disk is valid.
```

```
CDSTSB_CDROM        equ 4       ; Track 1 contains CD-ROM data
CDSTSB_PLAYING      equ 5       ; Audio is playing
CDSTSB_PAUSED       equ 6       ; Pause mode (pauses on play command)
CDSTSB_SEARCH       equ 7       ; Search mode (Fast Forward/Fast Reverse)
CDSTSB_DIRECTION    equ 8       ; Search direction (0 = Forward, 1 = Reverse)

CDSTSF_CLOSED       equ $0001
CDSTSF_DISK         equ $0002
CDSTSF_SPIN         equ $0004
CDSTSF_TOC          equ $0008
CDSTSF_CDROM        equ $0010
CDSTSF_PLAYING      equ $0020
CDSTSF_PAUSED       equ $0040
CDSTSF_SEARCH       equ $0080
CDSTSF_DIRECTION    equ $0100

; Modes for CD_SEARCH

CDMODE_NORMAL   equ 0       ; Normal play at current play speed
CDMODE_FFWD     equ 1       ; Fast forward play (skip-play forward
CDMODE_FREV     equ 2       ; Fast reverse play (skip-play reverse


*
******************************************************************************
*                                                                            *
* Position Information                                                       *
*                                                                            *
*      Position information can be described in two forms: MSF and LSN *
*      form.  MSF (Minutes, Seconds, Frames) form is a time encoding.  *
*      LSN (Logical Sector Number) form is frame (sector) count.       *
*      The desired form is selected using the io_Flags field of the    *
*      IOStdReq structure.  The flags and the union are described      *
*      below.                                                          *
*                                                                            *
******************************************************************************

STRUCTURE RMSF,0

    UBYTE   Reserved        ; Reserved (always zero)
    UBYTE   Minute          ; Minutes (0-72ish)
    UBYTE   Second          ; Seconds (0-59)
    UBYTE   Frame           ; Frame   (0-74)
    LABEL   RMSF_SIZE

;UNION

LSNMSF_SIZE     equ RMSF_SIZE


******************************************************************************
*                                                                            *
* CD Transfer Lists                                                          *
*                                                                            *
*      A CDXL node is a double link node; however only single linkage  *
*      is used by the device driver.  If you wish to construct a       *
*      transfer list manually, it is only neccessary to define the     *
*      mln_Succ pointer of the MinNode.  You may also use the Exec     *
*      list functions by defining a List or MinList structure and by   *
*      using the AddHead/AddTail functions to create the list.  This   *
*      will create a double-linked list.  Although a double-linked     *
*      list is not required by the device driver, you may wish use it  *
*      for your own purposes.  Don't forget to initialize the          *
*      the List/MinList before using it!                               *
*                                                                            *
******************************************************************************

STRUCTURE CDXL,0

    STRUCT  CDXL_Node,MLN_SIZE      ; double linkage
    APTR    CDXL_Buffer             ; data destination (word aligned)
    LONG    CDXL_Length             ; must be even # bytes
    LONG    CDXL_Actual             ; bytes transferred
```



```
    APTR    CDXL_IntData            ; interrupt server data segment
    APTR    CDXL_IntCode            ; interrupt server code entry
    LABEL   CDXL_SIZE

*
******************************************************************************
*                                                                            *
* CD Table of Contents                                                       *
*                                                                            *
*      The CD_TOC command returns an array of CDTOC entries.           *
*      Entry zero contains summary information describing how many     *
*      tracks the disk has and the play-time of the disk.              *
*      Entries 1 through N (N = Number of tracks on disk) contain      *
*      information about the track.                                    *
*                                                                            *
******************************************************************************

STRUCTURE TOCSummary,0

UBYTE   TOCS_FirstTrack          ; First track on disk (always 1)
UBYTE   TOCS_LastTrack           ; Last track on disk
STRUCT  TOCS_LeadOut,LSNMSF_SIZE ; Beginning of lead-out (end of disk)
LABEL   TOCSummary_SIZE


STRUCTURE TOCEntry,0

UBYTE   TOCE_CtlAdr                 ; Q-Code info
UBYTE   TOCE_Track                  ; Track number
STRUCT  TOCE_Position,LSNMSF_SIZE   ; Start position of this track
LABEL   TOCEntry_SIZE


;UNION

CDTOC_SIZE      equ TOCEntry_SIZE


*
******************************************************************************
*                                                                            *
* Q-Code Packets                                                             *
*                                                                            *
*      Q-Code packets are only returned when audio is playing.         *
*      Currently, only position packets are returned (ADR_POSITION)    *
*      The other ADR_ types are almost never encoded on the disk       *
*      and are of little use anyway.  To avoid making the QCode        *
*      structure a union, these other ADR_ structures are not defined. *
*                                                                            *
******************************************************************************

STRUCTURE QCODE,0

UBYTE   QCODE_CtlAdr                    ; Data type / QCode type
UBYTE   QCODE_Track                     ; Track number
UBYTE   QCODE_Index                     ; Track subindex number
UBYTE   QCODE_Zero                      ; The "Zero" byte of Q-Code packet
STRUCT  QCODE_TrackPosition,LSNMSF_SIZE ; Position from start of track
STRUCT  QCODE_DiskPosition,LSNMSF_SIZE  ; Position from start of disk
LABEL   QCODE_SIZE


CTLADR_CTLMASK  equ $F0     ; Control field

CTL_CTLMASK     equ $D0     ; To be ANDed with CtlAdr before compared

CTL_2AUD        equ $00     ; 2 audio channels without preemphasis
CTL_2AUDEMPH    equ $10     ; 2 audio channels with preemphasis
CTL_4AUD        equ $80     ; 4 audio channels without preemphasis
CTL_4AUDEMPH    equ $90     ; 4 audio channels with preemphasis
CTL_DATA        equ $40     ; CD-ROM Data

CTL_COPYMASK    equ $20     ; To be ANDed with CtlAdr before compared
```

```
CTL_COPY        equ $20     ; When true, this audio/data can be copied

CTLADR_ADRMASK  equ $0F     ; Address field

ADR_POSITION    equ $01     ; Q-Code is position information
ADR_UPC         equ $02     ; Q-Code is UPC information (not used)
ADR_ISRC        equ $03     ; Q-Code is ISRC (not used)
ADR_HYBRID      equ $05     ; This disk is a hybrid disk


ENDC
```


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May 19 1993

libraries/lowlevel.h

```
#ifndef LIBRARIES_LOWLEVEL_H
#define LIBRARIES_LOWLEVEL_H

/*
**      $Id: lowlevel.h,v 40.4 93/03/23 14:46:20 Jim2 Exp $
**
**      lowlevel.library interface structures and definitions.
**
**      (C) Copyright 1993 Commodore-Amiga, Inc.
**      All Rights Reserved
*/

/*****************************************************************************/

#ifndef EXEC_TYPES_H
#include <Exec/Types.h>
#endif

#ifndef UTILITY_TAGITEM_H
#include <utility/tagitem.h>
#endif


struct KeyQuery
{
    UWORD kq_KeyCode;
    BOOL  kq_Pressed;
};

#define LLKB_LSHIFT     16
#define LLKF_LSHIFT     (1<<LLKB_LSHIFT)
#define LLKB_RSHIFT     17
#define LLKF_RSHIFT     (1<<LLKB_RSHIFT)
#define LLKB_CAPSLOCK   18
#define LLKF_CAPSLOCK   (1<<LLKB_CAPSLOCK)
#define LLKB_CONTROL    19
#define LLKF_CONTROL    (1<<LLKB_CONTROL)
#define LLKB_LALT       20
#define LLKF_LALT       (1<<LLKB_LALT)
#define LLKB_RALT       21
#define LLKF_RALT       (1<<LLKB_RALT)
#define LLKB_LAMIGA     22
#define LLKF_LAMIGA     (1<<LLKB_LAMIGA)
#define LLKB_RAMIGA     23
#define LLKF_RAMIGA     (1<<LLKB_RAMIGA)

/*
***** ReadJoyPort() Return value equates *****
*/



/*
Port Type Equates :
*/

#define JP_TYPE_MASK            (15<<28)        /* controller type */

#define JP_TYPE_NOTAVAIL        (00<<28)        /* port data unavailable */
#define JP_TYPE_GAMECTLR        (01<<28)        /* port has game controller */
#define JP_TYPE_MOUSE           (02<<28)        /* port has mouse */
#define JP_TYPE_JOYSTK          (03<<28)        /* port has joystick */
#define JP_TYPE_UNKNOWN         (04<<28)        /* port has unknown device */

/*
Button Equates -  Valid for types: all except NOTAVIAL
*/
#define JPB_BUTTON_BLUE 23
#define JPF_BUTTON_BLUE (1<<JPB_BUTTON_BLUE)            /* Blue - Stop; Right Mouse */
#define JPB_BUTTON_RED  22
#define JPF_BUTTON_RED  (1<<JPB_BUTTON_RED)             /* Red - Select; Left Mouse;
Joystick Fire */
```


libraries/lowlevel.h

```
#define JPB_BUTTON_YELLOW       21
#define JPF_BUTTON_YELLOW       (1<<JPB_BUTTON_YELLOW)  /* Yellow - Repeat */
#define JPB_BUTTON_GREEN        20
#define JPF_BUTTON_GREEN        (1<<JPB_BUTTON_GREEN)   /* Green - Shuffle */
#define JPB_BUTTON_FORWARD      19
#define JPF_BUTTON_FORWARD      (1<<JPB_BUTTON_FORWARD) /* Charcoal - Forward */
#define JPB_BUTTON_REVERSE      18
#define JPF_BUTTON_REVERSE      (1<<JPB_BUTTON_REVERSE) /* Charcoal - Reverse */
#define JPB_BUTTON_PLAY 17
#define JPF_BUTTON_PLAY (1<<JPB_BUTTON_PLAY)            /* Grey - Play/Pause; Middle Mouse
*/

#define JP_BUTTON_MASK
```

libraries/lowlevel.i

```
IFND    LIBRARIES_LOWLEVEL_I
LIBRARIES_LOWLEVEL_I  SET 1
**
**      $Id: lowlevel.i,v 40.5 93/03/23 14:46:55 Jim2 Exp $
**
**      lowlevel.library interface structures and definitions
**
**      (C) Copyright 1993 Commodore-Amiga, Inc.
**      All Rights Reserved
**

;---------------------------------------------------------------------------

IFND    EXEC_TYPES_I
include "exec/types.i"
ENDC

IFND        UTILITY_TAGITEM_I
INCLUDE "utility/tagitem.i"
ENDC

STRUCTURE KeyQuery,0
    UWORD   kq_KeyCode
    UWORD   kq_Pressed
    LABEL   KeyQuery_SIZEOF


BITDEF  LLK,LSHIFT,16
BITDEF  LLK,RSHIFT,17
BITDEF  LLK,CAPSLOCK,18
BITDEF  LLK,CONTROL,19
BITDEF  LLK,LALT,20
BITDEF  LLK,RALT,21
BITDEF  LLK,LAMIGA,22
BITDEF  LLK,RAMIGA,23

;
; ***** ReadJoyPort() Return value equates *****
;

;
; Port Type Equates :
;
JP_TYPE_MASK            equ     (15<<28)        ; controller type

JP_TYPE_NOTAVAIL        equ     (00<<28)        ; port data unavailable
JP_TYPE_GAMECTLR        equ     (01<<28)        ; port has game controller
JP_TYPE_MOUSE           equ     (02<<28)        ; port has mouse
JP_TYPE_JOYSTK          equ     (03<<28)        ; port has joystick
JP_TYPE_UNKNOWN         equ     (04<<28)        ; port has unknown device

;
; Button Equates - Valid for types:  all except NOTAVAIL
;
BITDEF  JP,BUTTON_BLUE,23               ; Blue - Stop; Right Mouse
BITDEF  JP,BUTTON_RED,22                ; Red - Select; Left Mouse; Joystick Fire
BITDEF  JP,BUTTON_YELLOW,21             ; Yellow - Repeat
BITDEF  JP,BUTTON_GREEN,20              ; Green - Shuffle
BITDEF  JP,BUTTON_FORWARD,19            ; Charcoal - Forward
BITDEF  JP,BUTTON_REVERSE,18            ; Charcoal - Reverse
BITDEF  JP,BUTTON_PLAY,17               ; Grey - Play/Pause; Middle Mouse

JP_BUTTON_MASK          EQU
```


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May 19 1993

libraries/nonvolatile.h

```
#ifndef LIBRARIES_NONVOLATILE_H
#define LIBRARIES_NONVOLATILE_H

/*
**      $Id: nonvolatile.h,v 40.7 93/03/09 13:49:17 brummer Exp $
**
**      nonvolatile.library interface structures and defintions.
**
**      (C) Copyright 1992,1993 Commodore-Amiga, Inc.
**      All Rights Reserved
*/

/*****************************************************************************/

#ifndef EXEC_TYPES_H
#include <exec/types.h>
#endif

#ifndef EXEC_NODES_H
#include <exec/nodes.h>
#endif

struct NVInfo
{
    ULONG nvi_MaxStorage;
    ULONG nvi_FreeStorage;
} ;

struct NVEntry
{
    struct MinNode nve_Node;
    STRPTR nve_Name;
    ULONG nve_Size;
    ULONG nve_Protection;
};

/* Bit definitions for Mask in SetNVProtection().  Also used for
NVEntry.nve_Protection.                                                  */
#define NVEB_DELETE 0
#define NVEB_APPNAME 31

#define NVEF_DELETE (1<<NVEB_DELETE)
#define NVEF_APPNAME (1<<NVEB_APPNAME)

/* Errors from StoreNV(). */
#define NVERR_BADNAME   1
#define NVERR_WRITEPROT 2
#define NVERR_FAIL      3
#define NVERR_FATAL     4

/*****************************************************************************
*
*   Neat Macro
*       SizeNVData - Determine the size of data returned by this library.
*
*   FUNCTION
*       Determines the size of data returned by this library.
*
*       This macro will return incorrect information if called with data not
*       created by this library.
*
*       This function is actually implemented by a macro.
*****************************************************************************/
#define SizeNVData(DataPtr) ((((ULONG *) DataPtr)[-1]) - 4)

#endif
```

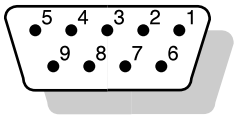

libraries/nonvolatile.i

```
IFND LIBRARIES_NONVOLATILE_I
LIBRARIES_NONVOLATILE_I SET 1
**
**      Id: nonvolatile.i,v 40.4 93/02/23 13:14:16 Jim2 Exp Locker: Jim2 $
**
**      nonvolatile.library interface structures and definitions.
**
**      (C) Copyright 1992,1993 Commodore-Amiga, Inc.
**      All Rights Reserved
**

;---------------------------------------------------------------------------


IFND EXEC_TYPES_I
include 'exec/types.i'
ENDC

IFND EXEC_NODES_I
include 'exec/nodes.i'
ENDC

STRUCTURE NVInfo,0
ULONG   nvi_MaxStorage
ULONG   nvi_FreeStorage
LABEL   NVINFO_SIZE

STRUCTURE NVEntry,0
STRUCT  nve_Node,MLN_SIZE
APTR    nve_Name
ULONG   nve_Size
ULONG   nve_Protection
LABEL   NVENTRY_SIZE

* Bit definitions for Mask in SetNVProtection().  Also used for
* NVEntry.nve_Protection.

BITDEF  NVE,DELETE,0
BITDEF  NVE,APPNAME,31

* Errors from StoreNV().
NVERR_BADNAME   EQU     1
NVERR_WRITEPROT EQU     2
NVERR_FAIL      EQU     3
NVERR_FATAL     EQU     4

*****************************************************************************
*
*   Neat Macro
*       SizeNVData - Determine the size of data returned by this library.
*
*   FUNCTION
*       Determines the size of data returned by this library.
*
*       This macro will return incorrect information if called with data not
*       created by this library.
*
*       This function is actually implemented by a macro.
*
*****************************************************************************
SizeNVData      MACRO   ;DataPtr SizeReg
move.l  -4(/1),/2
subq.l  #4,/2
ENDM

ENDC
```

5 Expansion Hardware

Connectors And Expansion Port

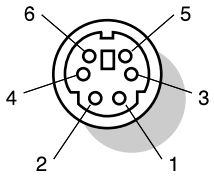
The joystick connectors have the same pinouts as the Amiga 500:



Joystick Port *(DB9 male)*

Pin 1 = Mouse V	Pin 6 = Mouse Button 1
Pin 2 = Mouse H	Pin 7 = +5v(100mA Max)
Pin 3 = Mouse VQ	Pin 8 = Ground
Pin 4 = Mouse HQ	Pin 9 = Mouse Button 3 (POTY)
Pin 5 = Mouse Button 2 (POTX)	

The auxiliary connector is for an optional keyboard. The pinouts are as follows:



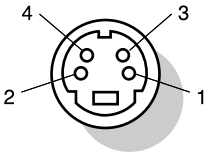
Auxiliary Port *(6-pin female mini DIN, PS/2-type)*

Pin 1 = Data	Pin 4 = +5 VDC (100 mA)
Pin 2 = n/c	Pin 5 = Clock
Pin 3 = Ground	Pin 6 = n/c

The Line Audio Output RCA jacks produce 2VRMS into an output impedance of 10KW.

The composite video output RCA jack produces a 1VP-P signal, coming close to meeting the RS170A specification for NTSC and the CCIR rep 624-2 specification for PAL.

The S-video connector provides 1VP-P luma and 320mVP-P chroma video signals. These signals are compatible with S-video monitors and C64-type monitors with separate chroma/luma inputs.

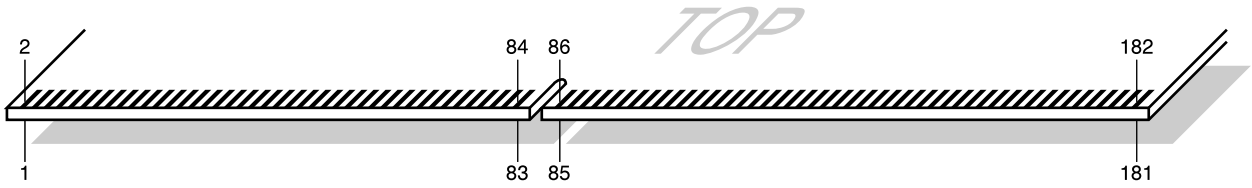


S-Video Port *(4-pin female mini DIN)*

Pin 1 = Ground	Pin 3 = 1VP-P Luma
Pin 2 = Ground	Pin 4 = 320m VP-P Chroma

The RF modulator output RCA jack provides an RF modulated version of the composite video and monaural audio on Channel 3 or 4 (VHF) for NTSC and Channel 36 (UHF) for PAL systems.

The expansion connector has gold fingers (15min plating min.) with 0.050" pitch. It will mate with a 32-bit Micro Channel Adapter (MCA) connector having 182 pins (AMP #650092-1). Note that while an MCA connector is used this is not an MCA expansion bus. The expansion connector is discussed later in this document.



Expansion Port *(MCA TYPE 182 pin Card Edge, P1)*

Pin 1 = A31
Pin 2 = A30
Pin 3 = A29
Pin 4 = A28
Pin 5 = A27
Pin 6 = A26
Pin 7 = A25
Pin 8 = A24
Pin 9 = DGND
Pin 10 = VCC
Pin 11 = A23
Pin 12 = A22
Pin 13 = A21
Pin 14 = A20
Pin 15 = A19
Pin 16 = A18
Pin 17 = A17
Pin 18 = A16
Pin 19 = DGND
Pin 20 = VCC
Pin 21 = A15
Pin 22 = A14
Pin 23 = A13
Pin 24 = A12
Pin 25 = A11
Pin 26 = A10
Pin 27 = A9
Pin 28 = A8
Pin 29 = DGND
Pin 30 = VCC
Pin 31 = A7
Pin 32 = A6
Pin 33 = A5
Pin 34 = A4
Pin 35 = A3
Pin 36 = A2
Pin 37 = A1

Pin 38 = A0
Pin 39 = DGND
Pin 40 = VCC
Pin 41 = D31
Pin 42 = D30
Pin 43 = D29
Pin 44 = D28
Pin 45 = D27
Pin 46 = D26
Pin 47 = D25
Pin 48 = D24
Pin 49 = DGND
Pin 50 = VCC
Pin 51 = D23
Pin 52 = D22
Pin 53 = D21
Pin 54 = D20
Pin 55 = D19
Pin 56 = D18
Pin 57 = D17
Pin 58 = D16
Pin 59 = DGND
Pin 60 = VCC
Pin 61 = D15
Pin 62 = D14
Pin 63 = D13
Pin 64 = D12
Pin 65 = D11
Pin 66 = D10
Pin 67 = D9
Pin 68 = D8
Pin 69 = DGND
Pin 70 = VCC
Pin 71 = D7
Pin 72 = D6
Pin 73 = D5
Pin 74 = D4

Pin 75 = D3
Pin 76 = D2
Pin 77 = D1
Pin 78 = D0
Pin 79 = DGND
Pin 80 = VCC
Pin 81 = _IPL2
Pin 82 = _IPL1
Pin 83 = _IPL0
Pin 84 = NC
Pin 85 = _RST
Pin 86 = _HLT
Pin 87 = NC
Pin 88 = NC
Pin 89 = SIZE_1
Pin 90 = SIZE_0
Pin 91 = _AS
Pin 92 = _DS
Pin 93 = R_W
Pin 94 = _BEER
Pin 95 = NC
Pin 96 = _AVEC
Pin 97 = _DSACK_1
Pin 98 = _DSACK_0
Pin 99 = CPUCLK_A
Pin 100 = NC
Pin 101 = DGND
Pin 102 = VCC
Pin 103 = FC2
Pin 104 = FC1
Pin 105 = FC0
Pin 106 = NC
Pin 107 = NC
Pin 108 = NC
Pin 109 = NC
Pin 110 = NC
Pin 111 = _CPU_BR

Pin 112 = _EXP_BG
Pin 113 = _CPU_BG
Pin 114 = _EXP_BR
Pin 115 = NC
Pin 116 = NC
Pin 117 = _PUNT
Pin 118 = _RESET
Pin 119 = _INT2
Pin 120 = _INT6
Pin 121 = _KB_CLOCK
Pin 122 = _KB_DATA
Pin 123 = _FIRE0
Pin 124 = _FIRE1
Pin 125 = _LED
Pin 126 = _ACTIVE
Pin 127 = _RxD
Pin 128 = _TxD
Pin 129 = _DKRD
Pin 130 = _DKWD
Pin 131 = DGND (SYSTEM)
Pin 132 = DKWE
Pin 133 = DGND (_CONFIG_OUT)
Pin 134 = NC
Pin 135 = DGND
Pin 136 = +12V
Pin 137 = DGND
Pin 138 = +12V
Pin 139 = 17MHz
Pin 140 = _EXT_AUDIO
Pin 141 = DA_DATA
Pin 142 = _MUTE
Pin 143 = DA_LRCLK
Pin 144 = DA_BCLK
Pin 145 = DGND
Pin 146 = VCC

Pin 147 = DR
Pin 148 = DG
Pin 149 = DB
Pin 150 = DI
Pin 151 = _PIXELSW_EXT
Pin 152 = _PIXELSW
Pin 153 = _BLANK
Pin 154 = PIXELCLK
Pin 155 = DGND
Pin 156 = VCC
Pin 157 = _CSYNC
Pin 158 = CCK_B
Pin 159 = _HSYNC
Pin 160 = _VSYNC
Pin 161 = VGND
Pin 162 = VGND
Pin 163 = AR_EXT
Pin 164 = AR
Pin 165 = AG_EXT
Pin 166 = AG
Pin 167 = AB_EXT
Pin 168 = AB
Pin 169 = VGND
Pin 170 = VGND
Pin 171 = _NTSC
Pin 172 = _XCLKEN
Pin 173 = XCLK
Pin 174 = _EXT_VIDEO
Pin 175 = DGND
Pin 176 = VCC
Pin 177 = AGND
Pin 178 = +12V
Pin 179 = LEFT_EXT
Pin 180 = LEFT
Pin 181 = RIGHT_EXT
Pin 182 = RIGHT

CD-ROM Subsystem

A separate PCB (2 layer) contains the CD electronics. This board contains the RF amp and servo chip, the audio DSP chip, and a small microcontroller for controlling the servo, focus, and communicating with the main CPU. The main CPU and RAM perform any prefetching, buffering and ECC as necessary.

The mechanism for the AmigaCD^{32} is a Sony KSM-2101BAM. The KSM-2101BAM has no drawer, or drawer motor. It is simply a spindle motor, traverse motor, and optical pickup. Chinon will provide the drive PCB. The electronics are based on the Sony CD chipset, which support double-speed operation. The microcontroller firmware has changed slightly in this version of the drive to (1) remove the firmware to control the drawer, and (2) revise the communications protocol to use a new 3-wire channel instead of the older 6-wire channel (to save pins on the ASIC) and (3) support multi-session discs (which is useful for PhotoCD support).

The software driver for the CD subsystem has been converted to run entirely on the 68EC020. The software also supports Akiko and its new DMA. This driver incorporates all the prefetching tricks and double-speed support completely from the 68EC020. It also supports both Mode 1 and Mode 2 (Form 1 and 2) discs. This is required to read all types of CD media called out in the Philips Yellow Book. This includes CD-I discs, PhotoCD® discs, and MPEG discs.

A Questions and Answers

Q1: *What should be in the startup-sequence? Just the name of the game executable or is something else needed?*

See Chapter 3 of this document for suggestions on startup-sequences.

Q2: *What non-volatile memory will exist on Amiga CD? Battery-backed RAM?*

The system is likely to support both NV-RAM and floppies as non-volatile memory. But try not to depend on the specific characteristics of one or the other. You should not rely on non-volatile memory being implemented as battery-backed RAM.

◗ *Any indication of size?*

The system call GetNVInfo() in the nonvolatile.library can tell you exactly how much memory there is and how much is currently available. Be aware that the user may be playing multiple games one right after the other. Commodore recommends that you avoid using more than 25% of the total NV memory available so that the system can remember the state of at least 4 different games while the power is off.

Q3: *After calling SystemControl(), exactly what pieces of the OS are left in?*

Taking over the system with SystemControl() and the SCON_TakeOverSys tag simply shuts down Exec multitasking. This means you get the CPU all to yourself and any system tasks are effectively starved until you make a call that directly or indirectly calls Wait(), WaitPort(). All "pieces of the OS are left in," they just don't get any time unless you allow it.

Q4: *Which of the following (see list below) still operate under OS control and which can we safely take over and hit directly?*

Even with multitasking shut down, the system hardware components are still nominally under the control of the OS, so you still have to allocate them before "hitting the hardware directly."

cd.device - ◗ *Is it still under OS control after system takeover?*

Yes.

◗ *How about when the CD is not being accessed?*

Yes, it is still nominally under the control of the OS.

Blitter -

◗ ***Do we need to call OwnBlitter() and DisownBlitter() ?***

Yes this is recommended. After calling OwnBlitter() call WaitBlit() before using the blitter. Call DisownBlitter() before exiting.

◗ ***Presumably cd.device uses the blitter?***

Currently it does not. This could change in a future version.

Audio -

◗ ***For normal Paula audio, can we hit audio registers directly and ignore audio.device?***

No. Allocate all the channels you want to use at the highest priority (127). Then you may hit the hardware directly.

Interrupts -

◗ ***Which ones does the OS have to have running?***

We do not want you to rely on such intimate information.

◗ ***Can we override VBI or does OS need its VBI too?***

The OS needs its VBI. Stick with the Exec handler chain scheme.

◗ ***How much overhead does the OS take?***

The OS interrupt routines take approximately 1/10 of 1% of CPU time.

Copper -

◗ ***Can we install our own custom copper lists without calling those long-winded graphics.library functions?***

Custom copper lists will not work on the next generation of Amiga hardware so they should generally be avoided. If you must use custom copper lists, then before poking your custom copper list into the cop1/2jmp registers you should call the sequence: LoadView(NULL); WaitTOF(); WaitTOF(); to maximize compatibility with future systems. Future chip sets will probably have better (32 bit) coppers and the system will want to use these. If you poke into the old copper registers, the graphics.library will have no way of knowing and can't switch back to the 16-bit mode. Therefore the best thing to do is:

```
temp=GfxBase->ActiView;
LoadView(NULL);
WaitTOF();
WaitTOF();
...              /* custom.cop1lc = your stuff */

WaitTOF();
WaitTOF();
LoadView(temp);
custom.cop1lc = GfxBase->copint;
```

Also, keep in mind that the V39 OS has new graphic.library functions for performing operations that previously required a custom copper list in older versions of the Amiga OS.

For instance, V39 ChangeVPBitMap() offers very low overhead double-buffering for animation. ScrollVPort() has been rewritten and is 10x faster in V39 so that scrolling with 60hz displays is no problem for multiple ViewPorts on the CD machine (and A1200/A4000). The V39 LoadRGB32() function allows 256-color cycling animation in 60 Hz displays without problems in multiple ViewPorts. Also, the VideoControl() function has new tags VC_IntermediateCLUpdate and VTAG_IMMEDIATE can be used to improve performance or change some of the more esoteric features (color banking, sprite resolution, priorities) that previously required custom copper lists.

Remember: task priorities and the copper-interrupt server chain are your friends. You may not need a custom copper list. Consider using the new V39 functions instead.

Q5: *CD_EJECT command seems to have no purpose?*

Yes, you're right. This is present for compatibility reasons.

Q6: *Why bother with CD_MOTOR? What is gained by turning the motor off? The description of the CD_MOTOR command is a little confusing too. Surely, you don't recommend this is done often (or at all) ?*

Indeed, there are very few good reasons to turn the CD motor off. Also, the CD_MOTOR Autodocs say "the spindle motor may automatically spin down if there is an absence of activity." This is in error. The system has no hidden "spin down." We will correct the docs.

Q7: *Since ReadJoyPort() allows for a mouse device, why is there no mouse support so that a mouse can be used with AmigaCD instead of the controller?*

There is mouse support. The ReadJoyPort() function returns a ULONG describing the type of the controller and its current state. If the type is JP_TYPE_MOUSE then the state information reflects the two mouse buttons (JPF_BTN1 and 2 are right and left respectively) and the vertical and horizontal mouse counter values (JP_MVERT_MASK and JP_MHORZ_MASK).

◗ ***What stops us from using a mouse if we choose to leave input.device running?***

Nothing. However, you don't need input.device. You can install a high-priority input handler or use ReadJoyPort() instead.

◗ ***It looks like the game controller can emulate a mouse. Is this true?***

The game controller can perform all the same functions as a mouse. However, it does not emulate the mouse at the hardware level.

Q8: *Does the game controller need input.device or can we kill input.device?*

If necessary, kill the input.device; the game controller does not need it. You can use SystemControlA() with the SCON_StopInput tag. Then use ReadJoyPort() to get controller information.

Q9: *We're unsure whether we have SimCD working properly. We seem to be able to call our application simply by CD'ing to the CD-partition on the hard drive and running the startup-sequence. (Admittedly, we are not using CD accesses yet.) Is this a side effect of setting up the CD-partition as an AmigaDOS device?*

The basic steps to using SimCD are as follows:

1. Set up a partition of the appropriate size on hard disk named CDN:.

2. Use ISOCD to create an ISO image of your programs and data files on the CDN: partition. You specify a source directory and a target partition. (Do not specify a file name for the image until you are ready to burn a gold disc.) Click on the Examine gadget and then the Build gadget. Exit.

3. Load SimCD. Under Configuration, select CDFS and cdtv.device only.

4. Set "Sim Device" to CDN: and hit the Simulate button.

5. SimCD sets up a simulated CD0: drive using the ISO image on CDN:.

6. Set your directory to CD0: and run your startup-sequence or executable.

◗ ***Do we need SimCD when we actually use cd.device calls within our application?***

No. SimCD currently emulates the older cdtv.device. We intend to upgrade SimCD, ISOCD and OPTCD in the future but they are not yet ready.

◗ ***We also find that after running SimCD, we can no longer use ISOCD to alter the CD-partition. We have to delete the partition and then create a new partition. This is a pain and only happens when we run SimCD. Is this normal?***

No. It is abnormal. When you want to change the image use ISOCD on CDN: (the partition name), *not* CD0: (the simulated CD drive).

Q10: *How do you use ISOCD to repeatedly alter your CD partition?*

The name of the partition you set up on hard disk to store the ISO image must *not* be named CD0:. This is reserved. Use CDN: instead. Then when you want to repeatedly use ISOCD, refer to CDN: (the partition name), *not* CD0: (the simulated CD drive). Also note that you should avoid using the "Add Extra Space" option; it is broken.

Q11: *SystemControl() Autodoc states that the OS needs "crucial interrupts" What are these interrupts?*

There are currently 11 low-overhead interrupts per second taking less than 1/10 of 1% of CPU time. We prefer that you do not rely on (or alter) which particular interrupts are the "crucial ones."

Q12: *In CD_READ, what is the byte offset parameter?*

It is a byte offset from the beginning of the CD disc.

◗ ***How do you calculate this byte offset?***

To read from a particular LSN (logical sector number), multiply the LSN by 2048 (there are 2048 bytes per sector, also known as a "frame"). Use this number for the byte offset parameter. For instance, the initial byte of LSN 1 would be byte offset 2048. The initial byte of LSN 2 would be byte offset 4096.

Q13: *How will gold discs be created?*

Send your ISO on DAT tape to the Maidenhead office, care of Sharon McGuffie. She will then have David Pocock cut a disc for you. If it works, he will cut an additional disc for examination in West Chester.

◗ ***Can we supply a DAT tape of an Amiga partition?***

Yes, we prefer a DAT tape of your ISO file, although we will try to be as flexible as time permits. If you do not supply an ISO, you are adding time to the process (if this is the case, be sure to include the volume name for the CD-ROM disc).

Q14: *Is the mouse included with the expansion box kit?*

Yes, we currently, we plan to include a mouse in the expansion box kit.

◗ ***What exactly will be included?***

The current plan is to include a keyboard, floppy and mouse. However, be aware that the bill of materials may change prior to actual release.

Q15: *What companies are recommended for disc production?*

For a complete list, see Chapter 2 of this document.

Q16: *What is going on with the different version numbers and names for calls?*

We have recently upgraded the system from V39 to V40.

V39 = AmigaDOS 3.0 as shipped in Sept. 92.
V40 = AmigaDOS 3.01 with CD extensions for game machine.

Q17: *What exactly does GetLanguageSelection() return?*

This was poorly documented. Sorry. The return values are:

```
#define    GAME_LANG_UNKNOWN        0
#define    GAME_LANG_AMERICAN       1
#define    GAME_LANG_ENGLISH        2
#define    GAME_LANG_GERMAN         3
#define    GAME_LANG_FRENCH         4
#define    GAME_LANG_SPANISH        5
```

```
#define    GAME_LANG_ITALIAN        6
#define    GAME_LANG_PORTUGESE      7
#define    GAME_LANG_DANISH         8
#define    GAME_LANG_DUTCH          9
#define    GAME_LANG_NORWEGIAN     10
#define    GAME_LANG_FINNISH       11
#define    GAME_LANG_SWEDISH       12
#define    GAME_LANG_JAPANESE      13
#define    GAME_LANG_CHINESE       14
#define    GAME_LANG_ARABIC        15
#define    GAME_LANG_GREEK         16
#define    GAME_LANG_HEBREW        17
#define    GAME_LANG_KOREAN        18
```

Q18: *What should be the process of development for the machine?*

1. Get a development system, an A4000 with a hard drive.

2. Develop or port game.

3. Test with ISOCD, SimCD and OPTCD on an A4000.

4. Transfer the ISO image onto DAT tape and send to Commodore in order to create a gold (master) disc. Or create the gold disc through other means.

5. Test gold disc on prototype CD game machine.

6. Repeat steps 2-5 until ready for duplication.

◗ ***What system is the suggested development system?***

An Amiga 4000 with an 040 is a good development platform. The '040 allows you to use MMU-based debugging tools. The A4000 has the AA chip set. You should MAPROM the V40 developer Kickstart release to make the A4000 more like the game machine OS. MapROM also allows you to upgrade as new V40 Kickstarts are released (no ROMs or EPROMs required). The IDE disk drive gives a close approximation of CD-ROM speeds. For faster, larger hard drives, use a 2091 or 4091 controller and a SCSI drive. (The 2091 controller board must have the 7.0 ROM set to work properly with the A4000.)

Q19: *Can you turn off the OS to get full control legally?*

Yes. See the game.library function SystemControlA() used with the SCON_TakeOverSys tag allows you to suspend pre-emptive multitasking effectively giving you full control of the CPU. You should still use the system-approved method of getting control of the hardware resources that you want before you hit the hardware directly.

Q20: *What parts will the development prototype have?*

It will consist of the prototype system with CD-ROM drive, a development-board that has Serial, Parallel, RGB, IDE and floppy connectors, and the game controller.

◗ ***Will you be able to run off of a hard disk?***

Yes with the development-board you can run your code and test it off of an IDE hard disk drive. With ISOCD, SimCD and OPTCD you can test the integrity of ISO images on hard disk (i.e., you don't have to cut a CD). However, be aware that the speeds are different (SimCD is slower than the actual CD will be) and low-level calls to cd.device will not work.

◗ ***Will you be able to make CD calls?***

You will not be able to make cd.device level calls to the ISO image on hard disk. However you can make cd.device calls to the CD-ROM.

Q21: *Can you play music off of the CD and get data at the same time?*

No. In general, this is a limitation of all current-generation CD systems. You can, however, load up Amiga audio data and start that playing in a loop while you load your data. Or you could load a compressed version of your executable files, then start playing CD audio after they are loaded, and then decompress your files and do other set up while the music plays.

Q22: *Is it legal to use the blitter?*

Yes it is. But please use OwnBlitter(), WaitBlit() and DisownBlitter() to get control of the hardware. This applies even if you have disabled multitasking with SystemControl().

Q23: *Can you use SNASM?*

Currently, you cannot use SNASM because there are some problems with SNASM and the '020 processor used in the game system. Also there is no SCSI connector on the game machine or the development board.

Q24: *Are there any calls which could guarantee that a program will be loaded to the same place in memory?*

No, there are none.

◗ ***I use SNASM and the code it generates is not relocatable (I think). What do you think?***

In general, non-relocatable code will have problems on the game system. A custom loader might possibly solve the problem. There are other problems using SNASM with the game system because of its '020 processor and lack of SCSI interface.

◗ ***If floppy drives are installed, will executables be loaded to a different memory location than they would be with no drives installed?***

Yes. The floppy drives use a buffer and has other overhead that requires some memory. This is likely to cause a program to be run in a different memory location than it would on a system with no floppy drives.

Q25: *Can you use some of the library calls to kill the OS?*

Basically yes. SystemControl() with the SCON_TakeOverSys tag disbales task switching effectively giving you full control over the CPU. You will be in full control until you call Wait() or WaitPort() either directly or indirectly.

◗ ***Will the OS cause a bottleneck with the normal 300 Kb/sec throughput because of cycle-stealing?***

Not if you disable task switching with SystemControl() and the SCON_TakeOverSys tag.

Q26: *What is the best communication method for asking questions?*

There are several methods. First, we have a closed conference on CIX. Please FAX your CIX name to John Campbell, director of CATS, at 0101-215-429-0643 so that you can be added to the conference. Second you can FAX your question directly to CATS (same FAX number). As a last resort call John Campbell at 0101-215-431-9184 or Carolyn Scheppner at 0101-215-431-9300.

Q27: *When the CD drive is in double-speed mode, how do you read the music and data files?*

You don't have to do anything special. The system handles it for you.

◗ ***Does the music automatically get handled?***

Yes. For CD-DA reads the drive will automatically slow down to single-speed mode.

Q28: *Will the game controller handle diagonals?*

Yes. The controller has a single omni-directional button that handles all 8 directions, similar to a joystick.

◗ ***Can the game controller emulate a mouse?***

It can perform all the same functions as a mouse. However, it does not emulate the mouse at the hardware level. Furthermore, games that are optimized for mouse usage are likely to be hard to play on a system equipped only with a controller.