Amiga CD32 Chipset Documentation

🎮 Amiga CD32 (32-bit Game Console)

The Amiga CD32 was Commodore's 32-bit CD-ROM game console released in 1993. Built on AGA (Advanced Graphics Architecture) technology from the Amiga 1200, it was designed specifically for gaming with enhanced graphics capabilities and CD-ROM support.

🔧 Architecture Overview

Core AGA Chipset (Advanced Graphics Architecture)

- **Alice 8374** - Main AGA graphics controller with 32-bit data bus
- **Lisa 8375** - AGA graphics support chip and memory controller
- **Paula 8364** - Enhanced audio/I/O controller with CD32 extensions
- **Akiko 8421** - CD32-specific system controller (the key differentiator)

CD32-Specific Enhancements

System Controller

- **Akiko 8421** - The heart of CD32 functionality
  - CD-ROM interface and control
  - Chunky-to-planar graphics conversion
  - 7-button joypad interface
  - NVRAM management

Audio & Video Output

- **TDA1387 Audio DAC** - 16-bit stereo CD-quality audio
- **CD32 RF Modulator** - TV output (PAL/NTSC)
- **CD32 Joypad Controller** - 7-button gamepad interface

Power & Control

- **CD32 Power Controller** - System power management and reset

📼 MPEG Cartridge (Full Motion Video)

The MPEG cartridge was an optional add-on that provided hardware MPEG-1 video decoding for Full Motion Video games and applications.

MPEG Decoder Subsystem

- **CL450 MPEG Decoder** - C-Cube Microsystems MPEG-1 video decoder
- **CL480 Video Controller** - Video timing and YUV to RGB conversion
- **MPEG DRAM Controller** - Video buffer memory management
- **MPEG Cart Interface** - Integration with CD32 system

MPEG Capabilities

- **Video Formats**: MPEG-1, VideoCD, CD-i FMV
- **Resolution**: 352×240 (NTSC) / 352×288 (PAL)
- **Color Depth**: 24-bit YUV 4:2:0
- **Frame Rate**: 30fps (NTSC) / 25fps (PAL)
- **Buffer Memory**: 1MB DRAM for video frames

📦 Package Types & Selection

AGA Graphics Chips:

- **Alice 8374**: PLCC-84, QFP-100
- **Lisa 8375**: PLCC-68, QFP-80

System Controllers:

- **Akiko 8421**: PLCC-84, QFP-100
- **Paula 8364**: DIP-48, PLCC-48

MPEG Cartridge:

- **CL450**: PLCC-84, QFP-100
- **CL480**: PLCC-68, QFP-80

Support Chips:

- **Audio DAC**: DIP-18, SOIC-18
- **RF Modulator**: DIP-16, SOIC-16
- **Controllers**: DIP-20, SOIC-20

🎯 Key Chip Functions

Akiko 8421 - The CD32 Heart

python

```
pins=[
    # CD-ROM Interface
    {'name': 'CD_D0'}, ..., {'name': 'CD_D7'},     # CD data bus
    {'name': 'CD_CLK'}, {'name': 'CD_REQ'},        # CD control

    # Joypad Interface
    {'name': 'JOY0_CLK'}, {'name': 'JOY0_LOAD'},   # Player 1 controls
    {'name': 'JOY1_CLK'}, {'name': 'JOY1_LOAD'},   # Player 2 controls

    # Chunky-to-Planar Conversion
    {'name': 'C2P_CLK'}, {'name': 'C2P_EN'},       # Graphics acceleration

    # NVRAM Interface
    {'name': 'NVRAM_CS'}, {'name': 'NVRAM_CLK'}    # Save game data
]
```

CL450 MPEG Decoder

python

```
pins=[
    # Host Interface (to CD32)
    {'name': 'HD0'}, ..., {'name': 'HD15'},        # Data to/from CD32
    {'name': 'HA0'}, ..., {'name': 'HA3'},         # Address bus

    # DRAM Interface (Video Buffer)
    {'name': 'MD0'}, ..., {'name': 'MD15'},        # Video memory data
    {'name': 'MA0'}, ..., {'name': 'MA11'},        # Video memory address

    # Video Output (YUV)
    {'name': 'Y0'}, ..., {'name': 'Y7'},           # Luminance
    {'name': 'U0'}, ..., {'name': 'U7'},           # Chrominance U
    {'name': 'V0'}, ..., {'name': 'V7'}            # Chrominance V
]
```

⚖️ CD32 vs CDTV Comparison

Feature	CDTV (1991)	CD32 (1993)
Chipset	OCS (Original)	AGA (Advanced)
Graphics	Agnus, Denise, Paula	Alice, Lisa, Paula, Akiko
Colors	4096 colors, 32 on screen	16.7M colors, 256 on screen
CPU	MC68000 @ 7.14 MHz	MC68EC020 @ 14.18 MHz
RAM	1MB Chip + 1MB Extended	2MB Chip RAM
Target	Multimedia center	Game console
Input	IR remote control	7-button joypad
Special	CD audio, remote	CD games, MPEG cart

🎮 Gaming Features

CD32 Joypad (7-button)

- **D-Pad**: Up, Down, Left, Right
- **Face Buttons**: Red, Blue, Green, Yellow
- **Shoulder Buttons**: Forward (L), Reverse (R)
- **System Button**: Play/Pause

Akiko Enhancements

- **Chunky-to-Planar**: Hardware conversion for faster graphics
- **CD-ROM Support**: Direct CD game loading and audio
- **NVRAM**: Battery-backed save game storage
- **Multiple Controllers**: Support for 2 joypads

📼 MPEG Cartridge Applications

Full Motion Video Games

- **Dragon's Lair** - Interactive movie game
- **Space Ace** - Don Bluth animated adventure
- **Microcosm** - 3D space shooter with FMV
- **Star Trek: The 25th Anniversary** - Adventure with video clips

Video Applications

- **VideoCD Playback** - Movies and music videos

- **CD-i Compatibility** - Some Philips CD-i video content
- **Karaoke Systems** - Background video with lyrics
- **Educational Content** - Interactive learning with video

🛠️ Integration with Visual Retro Emulator

Basic CD32 System:

```python
from chipsets.chipset_cd32_chips import add_cd32_chips
from retro_chip_generator import RetroChipGenerator

# Generate CD32 chip images
generator = RetroChipGenerator()
add_cd32_chips(generator)
generator.generate_images()
```

Building Complete Systems:

1. **Core AGA Layout**: Place Alice, Lisa, Paula in standard AGA configuration
2. **Add Akiko**: Position near Paula for I/O coordination
3. **Audio Chain**: Connect Paula → Audio DAC → RF Modulator
4. **Joypad Interface**: Wire Akiko to joypad controllers
5. **MPEG Expansion**: Add MPEG cartridge as modular component

Package Selection Workflow:

1. **Place Component** - Drag chip to canvas
2. **Select Component** - Click placed component
3. **Properties Panel** - Package dropdown appears
4. **Change Package** - Select PLCC, QFP, DIP, or SOIC
5. **Visual Update** - Chip appearance updates automatically

📊 Technical Specifications

Graphics (AGA)

- **Resolution**: Up to 1280×512 interlaced
- **Colors**: 16.7 million palette, up to 256 simultaneous

- **Sprites**: 8 hardware sprites, 16 pixels wide
- **Blitter**: Enhanced for AGA 32-bit operations
- **Display Modes**: PAL, NTSC, productivity modes

Audio

- **Channels**: 4 × 8-bit PCM channels (Paula)
- **CD Audio**: 16-bit stereo digital audio
- **Sample Rate**: Up to 28 kHz (Paula), 44.1 kHz (CD)
- **Output**: Stereo line out, RF modulated

MPEG Specifications

- **Standard**: MPEG-1 compliant
- **Video**: 352×240/288, 30/25 fps
- **Buffer**: 1MB DRAM for frame storage
- **Decoding**: Real-time hardware decoding
- **Overlay**: Transparent background support

🚀 Development Advantages

For Game Developers:

- **AGA Graphics**: Superior color depth and resolution
- **Hardware Acceleration**: Akiko's chunky-to-planar conversion
- **CD Storage**: 650MB capacity vs 880KB floppy
- **Audio Quality**: CD-quality sound and music
- **MPEG Video**: Cinematic cutscenes and presentations

For Emulator Builders:

- **Modular Design**: Core system + optional MPEG cart
- **Package Selection**: Multiple chip package options
- **Historical Accuracy**: Authentic chip specifications
- **Visual Representation**: Realistic chip images
- **System Simulation**: Complete hardware modeling

📁 File Structure

```
chipsets/
├── chipset_cd32_chips.py          # Main CD32 chipset definitions
examples/
├── cd32_example.py                # Integration example
images/components/
├── cd32_alice_plcc_84.png         # AGA graphics chips
├── cd32_akiko_plcc_84.png         # CD32 system controller
├── cd32_mpeg_cl450_qfp_100.png    # MPEG decoder chips
└── ... (more chip images)
```

🎉 Getting Started

1. **Generate Images**: `python examples/cd32_example.py`
2. **Add to Palette**: Include CD32 chips in component palette
3. **Build Systems**: Create CD32 configurations
4. **Add MPEG Cart**: Expand with Full Motion Video capability
5. **Test Package Selection**: Use Properties Panel dropdowns

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🎮 The CD32 chipset brings 32-bit gaming with AGA graphics and optional MPEG video to your Visual Retro Emulator!