CTrac™

CD Emulation System

Sega Mega CD Game Machine

ICOM SIMULATIONS, INC.

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With your convenience in mind, the CTrac emulation software has been supplied without copy protection. Remember that our continued support of this software relies upon your respect for its creator's efforts.

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Chapter 1 About the CTrac CD Emulation System

1.1 Introduction
1.2 CTrac Contents and Software Description
1.3 Hardware Requirements
1.4 Installation

1.1 Introduction

The CTrac CD Emulation System contains everything that is needed, hardware and software, to emulate compact discs for the Sega Mega CD System. The emulation system creates an image of a compact disc in a file on the hard disk drive of an AT. The system then acts as the CD drive by presenting the image to the Mega CD game machine, as if it were an actual compact disc. Since the emulation system replaces the CD drive, all formats and modes of a compact disc can be emulated including CD-DA, CD+G and CD+Midi.

Until now, the only accurate way to test CD applications was to have the application pressed on to a compact disc and then tested in the Sega Mega CD System. The process of pressing a disc to test an application under development is time consuming and costly, especially if the application does not work properly. Emulating CD applications with the CTrac Emulation System not only eliminates the need to have discs pressed for testing but also allows accurate monitoring of the commands sent to the CD drive.

The CTrac CD Emulation System hardware consists of a printed circuit board that plugs into an IBM AT or compatible. The CTrac hardware, together with the CTrac software running on the AT, emulates the CD drive in the Sega Mega CD game machine. The emulation is completely transparent.

This documentation assumes a working familiarity with the Sega Mega CD System and a general understanding of the structure of a compact disc. For more information on compact discs, refer to the *N.V. PHILIPS CD Red Book* or *Yellow Book* standards and the *International Standard for CD-ROM Information Processing* booklet (reference number ISO 9660 : 1988 (E)). Before installing and attempting to use the CTrac Emulation System, it is recommended that this entire booklet be read and understood. For technical support, inquiries or proprietary technical information concerning the CTrac CD Emulation System, contact Sega.

1.2 CTrac Contents and Software Description

Hardware

The CTrac emulation hardware consists of the following:

- CTrac emulation printed circuit board

Software

The CTrac emulation software consists of the following files:

- SEGA.EXE

The emulation software.

- BD.EXE

BuildDisc is a tool used to create entire CD images for the CTrac Emulation System. It combines track images, along with the proper subcode information, into one composite disc image. The final disc image is needed for the emulation software.

- BT.EXE

BuildTrack is a tool used to create ISO 9660 formatted tracks that are needed on the compact discs used in the Sega Mega CD System. The output of this program is used as input for the BuildDisc program.

- ISOUtil.EXE

A tool used to extract, update and list directories of files contained in ISO track images or from disc images that contain ISO tracks.

1.3 Hardware Requirements

An IBM AT or 100% compatible satisfying the following requirements:

- 640K of RAM
- a free 16 bit expansion slot
- an EGA or VGA graphics card
- 386 or 486 processor running at 25 MHz or faster
- DOS version 4.0 or higher
- a large and fast hard drive

Compact discs may contain varying amounts of data up to a maximum of approximately 794 MB. Since the image of a compact disc is stored in a file on the hard drive of the AT, it follows that the hard drive used must be at least as large as the largest image that will be emulated. Moreover, it may be desirable to store the source data and track images that were used to build the disc image on the same hard drive. If this is done, it could more than double the amount of storage space required. Therefore, a 600MB or larger drive is strongly recommended. The hard drive must also be reasonably fast because the emulator requires at least a 500K bytes/second maintainable data rate.

1.4 Installation

Step One: Copy the following CTrac emulation software and tools to a directory in your command execution path on the AT hard drive: SEGA.EXE, BD.EXE, BT.EXE and ISOUTIL.EXE. Store the original floppy in a safe place.

Step Two: Examine the emulator board for any obvious signs of damage. If it is damaged, do not attempt to install the board. While examining the board, make sure the DIP switches are set correctly.

The JP1 DIP switch controls the interrupt setting. Only one switch may be set ON at a time. The IRQ9 interrupt should be enabled on the emulator board by default.

	IRQ9	IRQ10	IRQ11	IRQ12
JP1-1	on	off	off	off
JP1-2	off	on	off	off
JP1-3	off	off	on	off
JP1-4	off	off	off	on

The SW1 and SW2 DIP switches control the address that the board is mapped in to. The board requires 8K of memory. Make sure the area of memory the board uses does not conflict with other cards, EMS memory or BIOS ROM's. If the memory segment does conflict and needs to be reconfigured, the table below shows some examples of possible memory locations and the corresponding switch settings. The emulator board should be set to D800 by default.

	A13	A14	A15	A16	A17	A18	A19	
	SW2-1	SW2-2	SW2-3	SW2-4	SW1-1	SW1-2	SW1-3	SW1-4-8
C800	on	on	off	on	on	off	off	on
CC00	on	off	off	on	on	off	off	on
D000	on	on	on	off	on	off	off	on
D400	on	off	on	off	on	off	off	on
D800	on	on	off	off	on	off	off	on
DC00	on	off	off	off	on	off	off	on
E000	on	on	on	on	off	off	off	on
E400	on	off	on	on	off	off	off	on
E800	on	on	off	on	off	off	off	on
EC00	on	off	off	on	off	off	off	on

If the address and/or interrupt needs to be reconfigured, the following two commands can be defined in the AUTOEXEC.BAT file. The emulation software uses the values specified to locate the board.

```
SET SEGABOARDADDRESS=XXXX
SET SEGAINTERRUPT=XX (where X is a hex digit)
```

For example, if the address was changed to D400 and the interrupt was changed to IRQ11, the commands would be defined as follows:

```
SET SEGABOARDADDRESS=D400
SET SEGAINTERRUPT=0B
```

Step Three: Disconnect power from the AT, open it and locate a free expansion slot. Remove the metal flange from the empty slot and retain the screw.

Step Four: Place the emulator card in the slot firmly. Do not screw in the emulator card or close the AT until it has been verified that the board is operational.

Step Five: Make sure the Sega Mega CD game machine is assembled correctly. See the Sega Mega CD System installation documentation for further details.

Step Six: Connect the interface cable between the emulator adapter and the emulator board in the AT.

Step Seven: When invoked with the -t option, the CTrac emulation program tests the RAM on the emulator board in the AT, verifies that the interrupts are operating and reports the results. Invoke the emulator with the following command:

```
SEGA -t
```

If an error message occurs that cannot be traced and fixed, the card is not operational. If this is the case, check for address and IRQ conflicts. If errors are still occuring, power off the AT and remove the card.

Step Eight: Power off the AT and using the screw from the metal flange, screw down the emulator card in the expansion slot firmly.

The CTrac Emulation System is now installed and ready for use. See section 2.4 Creating a Disc Image for Emulation for a general outline on the various steps for creating a disc image for emulation.

Chapter 2 The CTrac Emulation Software

2.1 Invoking the Emulation Software
2.1.1 Command Line Options
2.2 Loading a Disc Image
2.3 Status Window
2.3.1 Emulation Errors
2.4 Creating a Disc Image for Emulation

2.1 Invoking and Exiting the Emulation Software

Invoking the Emulator

To invoke the emulation software, use the following command format:

```
SEGA [options] [imageFileName] [options]
```

Without a file name specified, the emulation will begin as if a disc has not been loaded into the compact disc player. The emulation invocation command, the image file name and any command line options must be separated be at least one space.

Exiting the Emulator

To exit the emulator at any time, press the letter "Q" on the keyboard.

2.1.1 Command Line Options

At least one space must be used between the emulation software invocation command and the command line options. If multiple options are specified, they must be separated by at least one space. Extra spaces are ignored. All options are case sensitive. If an option is specified incorrectly, a listing of the options and a brief description of each will appear at the DOS prompt.

-s

Disables seek time emulation. Therefore, spin-up, spin-down and seek delays are not emulated. Seek time emulation can also be disabled from within the emulation program. Disabling seek time emulation is useful for testing applications at the fastest possible speed.

-t

Tests the emulator card, reporting the results, and then exits. Use this option only when you wish to test the emulator card and exit. If an error is reported after using this option or when the emulation software is invoked, contact Sega.

-v

When used, verbose mode becomes active. This causes all commands to be reported in the Status Window of the emulation program. Verbose mode can also be enabled from within the emulation program.

The commands in the Status Window are commands the emulator receives from the Sega Mega CD machine. When verbose mode is inactive, the commands that are sent repeatedly and often to the emulator are not reported. Because the repeated commands can obscure the more important commands in the Status Window, verbose mode is inactive by default.

2.2 Loading a Disc Image

To load a disc image within the emulation program, "open" the CD drive door. A file prompt will appear in the Status Window. Enter the image file name. Press Return or "close" the drive door to begin emulation. If the image file specified is not a valid disc image or could not be found, an error message will appear.

The following function keys are available to edit the file name. All editing is done in Insert mode.

Ctrl X

Clears the line of text.

ESC

Restores the name of the last image file emulated.

left/right cursor arrow keys

Moves the cursor on the prompt line.

Backspace

Deletes the letter before the cursor.

Delete

Deletes the current letter at the cursor.

Return

Emulates "closing" the door on the CD drive. The file entered will begin emulating.

2.3 Status Window

The main window, the Status Window, displays all commands received from the Mega CD System. The bottom line of the Status Window displays the drive status, whether or not the emulator options are enabled or disabled and the current track and time, in minutes:seconds:blocks, being emulated.

Drive Status:

All actions of the CD drive are emulated. The actions emulated and reported are described below.

Door Open/Closed

Indicates if the drive door is open or closed.

Door Opening/Closing

Indicates that the drive door is in the act of opening or closing.

Not Focused/Focusing/Focused

Reports the status of the lens as it attempts to focus on the compact disc inserted into the CD drive.

Stop/Pause/Play

Indicates whether the CD drive is in stop, play or pause mode.

Time

Displays the current track number and current time of the disc image or displays "TOC" if the table of contents area is being accessed during emulation. The time is displayed in minutes:second:blocks.

Emulator Options:

The emulator options can also be enabled or disabled from the command line. See section 2.1.1 Command Line Options for more information.

Seek Emulation ON/OFF

Seek time emulation can be enabled or disabled. If it is disabled, spin-up, spin-down and seek delays are not emulated. Disabling seek time emulation allows the application to be tested at the fastest possible speed, however, emulation is inaccurate. To toggle seek time emulation on and off, press the letter "S" on the keybord.

Verbose Mode ON/OFF

When enabled, all commands the emulator receives from the Mega CD machine are reported in the Status Window of the emulation program. When verbose mode is disabled, the commands that are sent repeatedly and often to the emulator are not reported. To toggle verbose mode on and off, press the letter "V" on the keybord.

2.3.1 Emulation Errors

Errors that keep the emulator from functioning properly are reported in the Status Window. These errors are referred to as emulation errors. The following is a list of the errors that could occur during emulation and an explanation of the possible causes. Emulator errors do not abort emulation. The emulator will attempt to recover from whatever error is encountered. Depending on the error, it may or may not be successful. To delete a flashing error message in the Status Window, press the letter "R" on the keyboard.

Δ *Note:* For proper emulation, trace down and fix all reported errors before continuing.

`Emulation compromised, bank IRQ reentered!`

The emulator receives interrupts on a regular basis. When it receives an interrupt, it begins a task to copy data to the Mega CD machine. If this task does not complete quickly enough, this error will occur. The effect of this on emulation is similar to the effect of a CD drive skipping due to excessive vibration. The emulator will attempt to regain calibration and continue from the point it encountered the error.

`Emulation compromised, file read did not keep up`

The emulator needs to maintain a constant data transfer rate of 175K per second. If it cannot maintain this rate, this error will occur. It can be caused by any of the following conditions:

- The hard drive that contains the disc image is not fast enough.
- Disk cache software is being used.
- DOS buffers are set too low.
- The image file is excessively fragmented.
- The cluster size of the hard drive may be too small.
- The machine processor may be too slow.

2.4 Creating a Disc Image for Emulation

Discs for the Sega Mega CD System normally contain an ISO 9660 formatted CD-ROM Mode 1 track and additional CD-DA or CD-ROM tracks. The following is a general outline of the steps that need to be taken to create a disc image for emulation.

I. Create a track file that contains an entire ISO 9660 volume structure. *BuildTrack* is the tool that is used for this purpose. See the *BuildTrack* documentation for more complete information on creating track images.

A. Create a control file for *BuildTrack*. The control file specifies which files to include in the ISO 9660 track and the order of each. The control file also allows other attributes of the ISO 9660 track to be specified.

B. Run *BuildTrack* using the control file. A track image will be created that contains the entire ISO 9660 image.

C. If other tracks are going to be included in the disc image, such as CD-DA, they will need to be created at this time.

II. Create the disc image from the tracks created in Step I. *BuildDisc* is the tool used for this process. See the *BuildDisc* documentation for more complete information on creating disc images.

A. Create a control file for *BuildDisc*. The control file specifies which tracks will be included in the disc image and the order of each. It also allows other attributes of the disc to be specified, such as the length of the table of contents (TOC).

B. Run *BuildDisc* using the control file. The disc image will be created with the track images that were specified. The disc image that is created can then be used for emulation.

III. Run the emulator using the disc image.

IV. Once the application is tested, the files on the track image can be listed and updated without having to rebuild the track and disc images. *ISOUtil* is the tool used for this process. See the *ISOUtil* documentation for instructions.

Appendices

Appendix A Error Messages

Appendix A Error Messages

The following is a list of messages that the CTrac Emulation System can generate and some of their possible causes. When an error message is generated, execution is ended.

```
Failed to initialize 6303.
Failed to initialize emulation.
Failed to initialize interrupts.
Failed to initialize hardware.
```

Any of these errors indicate a malfunction in the emulator board in the AT. Make sure the board is inserted into the AT correctly. Also, check for address and interrupt conflicts. If any of the errors are still occuring, remove the card and contact Sega.

```
Could not allocate enough memory for buffers.
```

The emulator requires 350K of free memory. This memory could not be allocated. Free up the required memory and try again.

```
Failure to recognize emulator board.
```

There is an address and/or interrupt conflict. The emulation software cannot locate the board. If you are using the default address and interrupt, D800 and IRQ9, check the DIP switches on the board and make sure they are set correctly. Also, make sure the default settings do not conflict with other boards installed in the AT. If you reconfigured the address and interrupt, make sure the following two command are specified correctly. The emulation software uses the values specified to locate the board.

```
SET SEGABOARDADDRESS=XXXX
SET SEGAINTERRUPT=XX (where X is a hex digit)
```