CTrac™ Emulator for Sega Genesis

User Guide

1. Introduction

CTrac Emulator is a combination of hardware and software designed to be used in conjunction with a Sega Genesis game machine and a 386 MS-DOS compatible computer to enable the speedy development and testing of CD based software products for the Sega Genesis game machine. It provides transparent, hardware level emulation of the Genesis' optional CD drive so that programs can be developed without the costly and time consuming process of making test CD-ROMs.

2. How CTrac Emulator works.

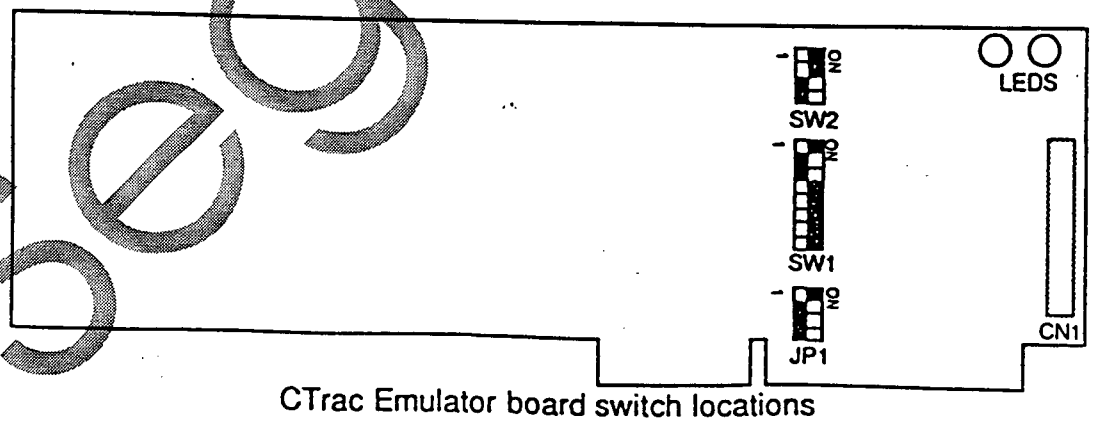
The Emulator functions by using a combination of hardware and software to mimic the actions of the Genesis CD drive. During normal operation, the lowering of the Command Line signal of the CD drive controller causes an interrupt. The Emulator driver responds by handshaking with the CD drive controller and receiving the new command. The driver then interprets the command and responds with the appropriate status information. If the command request a data transfer, the driver converts the sector address received with the command to the corresponding location in the CD image located on the hard disk of the MS-DOS machine. It then fetches the data requested from the CD image and transfers it to the next available buffer in the double buffered transfer memory located on the Emulator card. The hardware on the card then transfers this data to the CD controller of the Genesis machine at the correct data transfer rate required by the controller.

3. Installing the Emulator board.

To install the Emulator board you must set the switch settings on the board, place the board in the 386 MS-DOS machine, and then connect the board to the Genesis machine using the cable supplied. These steps are detailed below.

3.1 Setting the Emulator Switches.

There are three switch blocks on the Emulator card, as shown in the diagram below. Switch blocks SW1 and SW2 is used to set the segment address of the 8k block of memory used by the board. Switch SW3 (labeled as JP1 on the beta board) is used to set the the interrupt request line (IRQ) that is used by the board.



CTrac Emulator board switch locations

Note that the direction of a switch being "on" (shown as up in the diagram) may be either up or down, depending on the particular type of switch block used. Please look at the markings on the switch block of your board to make sure.

The meaning of each switch in SW1, along with its default location as shipped, is shown in the table below:

Switch	OFF	ON	Meaning
1		X	Segment address bit 17 (off is 1, on is 0)
2	X		Segment address bit 18 (off is 1, on is 0)
3	X		Segment address bit 19 (off is 1, on is 0)
4		X	Segment address bit 20 (off is 1, on is 0)
5		X	Segment address bit 21 (off is 1, on is 0)
6		X	Segment address bit 22 (off is 1, on is 0)
7		X	Segment address bit 23 (off is 1, on is 0)
8		X	Enable (when off, board will not respond to bus cycles)

The meaning of each switch in SW2, along with its default location as shipped, is shown in the table below:

Switch	OFF	ON	Meaning
1		X	Segment address bit 13 (off is 1, on is 0)
2		X	Segment address bit 14 (off is 1, on is 0)
3	X		Segment address bit 15 (off is 1, on is 0)
4	X		Segment address bit 16 (off is 1, on is 0)

The board occupies an 8k block of memory, starting at the address set in switch block SW1. The factory set default setting is 1101100x in binary or $0D800 in hex. This address was chosen since it is normally unoccupied in most MS-DOS computers. The switch block is provided in case your MS-DOS computer has some other memory or memory mapped I/O at the $0D800 address. If this is the case, reset the switch to place the Emulator board at a different address which has no conflict. If you have to do this, the Emulator driver software will have to be set up to look for the board at the new address. The procedure to do that is discussed below in section 4.

The third switch, SW3, (labeled as jumper pad JP1), is used to choose the interrupt request line (IRQ) that the board uses to cause an interrupt and get the driver to perform some needed action. The IRQ selected is switch is on. NOTE: Only one switch can be on at a time. Putting two switches in the ON position will result in unpredictable behavior.

Switch	OFF	ON	Meaning
1		X	Interrupt IRQ 9
2	X		Interrupt IRQ 10
3	X		Interrupt IRQ 11
4	X		Interrupt IRQ 12

As shown, the default, factory setting selects IRQ 9.

3.2 Inserting the Emulator board.

Once the board is set up, as described in section 3.1 above, it can be inserted into the MS-DOS computer. Any unused, 16 bit "AT" style slot can be used. Simply plug the board into the desired bus connector.

At this point, before connecting the Emulator board to the Genesis machine, it is a good idea to test the board to see that there are no conflicts with the chosen address and IRQ settings. Power up the MS-DOS computer, make sure the Emulator driver software is installed correctly (as described in section 4 below), and run the Emulator driver. If the driver does not report an error, then the board is functioning properly and you can proceed with connecting it to the Genesis machine.

3.3 Connecting to the Genesis.

You are now ready to connect the Emulator card to the Genesis machine. First make sure that both computers are turned off and disconnected from the wall socket.

THE REST OF THIS SECTION IS LEFT UNFINISHED SINCE THE CABLING IS NOT IN ITS FINAL FORM. A CABLE SHOULD CONNECT THE EMULATOR CARD WITH THE CONNECTION POINTS IN THE CD INTERFACE THAT NORMALLY CONNECT TO THE CD DRIVE.

4. Installing the Emulator Driver Software.

The Emulator driver software is contained in the DOS disk file called EMULATE.EXE. To install the program, simply copy it to the hard disk on your MS-DOS computer. It can be placed in any convenient directory. The EMULATE program and the disc images to be emulated do not have to be in the same directory. Also copy the file SEGAEMU.HEX to the same directory where you placed EMULATE.EXE. It contains the program for the microprocessor on the Emulator card.

If the default board address ($D800 hex) or the default IRQ number (9) have been changed on the emulator board, the MS-DOS system must be configured to inform the EMULATE program of the changes. This is done by using the DOS SET command to modify a DOS environment variable. To change the board address, the command

SET SEGABOARDADDRESS=NNNN

should be used, where NNNN represents the hexadecimal segment address of the board. For example, if the board were set to $E400, then use

SET SEGABOARDADDRESS=E400

To change the interrupt request number (IRQ), use the command

SET SEGAINTERRUPTNUM=NNNN

where NNNN represents the hexadecimal IRQ number. For example, if the board were set to interrupt request 11, then use

SET SEGAINTERRUPTNUM=000B

If either of these commands need to be used, it is recommended that they be placed in the AUTOEXEC.BAT file on the MS-DOS computer. That way they will be automatically executed whenever the machine is started, and the EMULATE software will always be ready to function properly.

5. Operating the Emulator.

To run the Emulator, change to the directory that contains the EMULATE.EXE file and simply type in the command "EMULATE" at the DOS prompt. You may also specify a filename of a disc image to be emulated. This filename can be a complete pathname as well. For example,

EMULATE \IMAGES\OS\SEGA.DSC

The Emulator driver recognizes the following commands. Each command is executed by pressing the appropriate key on the keyboard:

Q Quit the Emulator driver and return to DOS
S Toggle seek emulation ON or OFF. The current status is shown on screen.

Normally, the O command would open the disc door and allow a disc to be inserted, but in the case of the Sega emulator, only the controlling Genesis machine can open the disc door. To insert a virtural disk, use the Genesis to open the disc door. The Emulator signals a No Disc status and you are prompted for a DOS path/filename of a disc image to emulate. The filename of the last disc image that was being emulated will be displayed on the input line with the cursor at the end of the line. You can use the left and right arrow keys, along with the backspace key, to edit the filename. The original filename can be recalled at any time by pressing the ESC key. Typing the CTRL X key combination will clear the filename line. When you have entered the desired filename, press return to start emulating. If the file does not exist, or it is not a valid disc image, an error will occur and the No Disc status will still be shown. Pressing RETURN with no filename entered is the same as closing the CD drive door with no disc in place.

Note that you must have done a DOS CD command to the directory that contains EMULATE.EXE and SEGAEMU.HEX before you execute the emulator. The driver program looks in the current directory for SEGAEMU.HEX, and will abort if it doesn't find it.

6. Startup Procedures.

To start an emulation session, power on the MS-DOS computer and run the emulation driver. Now power on the Genesis machine, open the disc drive door, and , selecte the Sega disc image.

7. Error Messages.

The following are all of the error messages that may appear while running the Emulator Driver software, along with a description of their meaning.

`Failure to recognize emulator board.`
Emulation driver software could not find the Emulator board. Most likely the switch or jumper pad on the board is not set correctly or the driver software was told the wrong address. Check the switches as shown in sections 3.1 and 4, above.

`Could not allocate enough memory for buffers.`
The Emulation driver software needs at least 384k of free memory to run. Make sure more memory is available and rerun the program.

`File Not Found`
The file specified by the filename/pathname given to the Emulator Driver software as the name of a disk image was not found. Check the filename and try again.

`Invalid Disc Image.`
The file specified by the filename/pathname given to the Emulator Driver software as the name of a disc image was not a valid disc image. Either the file was not created by CTrac Builder, or it has been corrupted.

`Emulation Compromised, file read did not keep up.`
This message appears when the data requested by the Towns machine could not be retrieved in the amount of time available. If this message occurs once or twice, then it usually means that there is a spot on the hard disk which has soft error problems, and by the time the hard disk controller corrected the data, too much time had passed. If the problem recurs often, then either the hard disk, the hard disk controller, or the MS-DOS computer is too slow for emulation work.

`Emulation Compromised, reentered bank IRQ.`
This error message will appear when the Emulator board's memory bank interrupt, which occurs 75 times per second, happened before the bank interrupt routine is finished with the last interrupt. This usually would be caused by an incompatibility with another board in the MS-DOS computer. If another board is in the system that is using the same IRQ as the Emulator, then either the board must be removed or the Emulator's IRQ must be changed. To change the IRQ, see sections 3.1 and 4.

`Data ram failed`
`Subcode ram failed`
A bad RAM chip was found on the Emulator board. Contact your dealer for service.

`6303 RAM test failure.`
`Clock test failure.`
`Failed to initialize 6303.`
`Failed to initialize Emulator.`
`Failed to initialize interupts.`
`Faile to initialize hardware.`
Any of these messages indicate a hardware failure during startup. You should contact ICOM Simulations.