

Game Support System ERCACHE

<< User Manual: Disk Cache Edition >>

Error15 CQF15666 : PC-VAN

May 20, 2000 Compatible with Version 3.01

--- Chapter 1: Introduction ---

ERCACHE is a general term for a game support system designed to comfortably use games, N88-BASIC(86), and other applications under MS-DOS or non-MS-DOS environments. This DOC file explains its disk caching features. For other features, please refer to the general manual (ERCACHE.DOC), etc. In the explanations below, "games" will mostly be used as the example, but the same applies to MS-DOS and N88-BASIC(86).

1.1 ERCACHE Disk Cache System Overview

The disk cache function—the original purpose of ERCACHE since Ver 1.00—is designed to cache floppy disks even in non-MS-DOS environments to allow smooth gaming. It does not target games installed on a hard disk. While new floppy disk games will likely no longer be released, this system remains effective when running older games. Furthermore, if your system has an 80386 or higher CPU and sufficient protected memory, running everything on a hard disk using virtual FDs will yield a more comfortable experience.

1.1.1 Main Features

The primary features when using ERCACHE as a disk cache are as follows. Some functions may not be available depending on your environment; please refer to the respective chapters for details.

(1) Floppy Disk Caching

The core feature since ERCACHE Ver 1.00. It supports both EMS memory and protected memory, enabling caching in almost any environment to make game performance smooth.

(2) Memory Control Features

Equipped with a Virtual 86 Monitor to implement Virtual 86 Banks.

(3) CPU Control Features

Enables cache control for Cx486SLC/DLC/IBM486SLC2 processors.

(4) Image Capture Feature

In Virtual 86 mode, when used together with ERCGSV.EXE (provided in a separate archive), image data (digital 8-color, analog 16-color, and 256-color) can be saved to MAG or BMP format files.

(5) MIDI Emulation Feature

In Virtual 86 mode, it realizes an environment equivalent to MPU-PC98II by utilizing the MPU ports of the PC-9801-118, RS-232C (equivalent to SC-55mkII or EMU-232), or SoundBlaster16.

(6) FM Sound Generator Support Feature

In Virtual 86 mode, it allows swapping I/O ports for FM sound chips and joysticks, as well as converting conventional audio into stereo.

(7) HSB Interlocking Feature

Enables high-speed rebooting utilizing HSB.EXE (c)Masao.

1.2 Compatible Environments

1.2.1 Hardware

- o PC-9800/9821 Series (Main memory 640KB or more)

- o PC-286/386/486/586 Series

- o 2MB or more Protected Memory (including EMJ/PIO-PC34)

- o 2MB or more EMJ-MKII/MKIII/L/R/S (early model) Series

- o 2MB or more PIO-PC34E/H/F/FX/R Series

(At least one of the above 3 memory types must be present; only 1 type can be used at a time)

- o 1MB type Floppy Disk Drive (internal built-in drives supported)

(1) It should operate on most standard hardware models.

It may not work on the 98NOTE series or similar models.

(2) It does not work in High-Resolution mode.

(3) The cache memory required is approximately 1.5MB per FDD. For smooth operation, expanding your RAM by at least 4MB (ideally 8MB) is recommended.

(4) EMJ-compatible products (EML/EMP/RCS) likely will not work.

It will not operate on EMA/EMZ/EM-2000/RCN/RCB/RCD/EMB/ESB.

It will also not operate on the first-generation EMJ or the new model EMJ-S.
There are no plans to support non-working EMJ boards unless there is a significant volume of requests.

1.2.2 Software

MS-DOS Ver 3.1 or later is required (Operation confirmed only on NEC 3.3C and 5.0A).
Additionally, to fully utilize this system when employing it as a disk cache,
the following software is required:

o HSB.EXE Ver 3.1Q or later (Ver 3.7 or later recommended) (c)Masao

A DOS utility to perform high-speed system reboots. It can pass control to ERCACHE after initialization, or initialize and reboot the system while leaving ERCACHE's Virtual 86 mode active.
This is required unless you are using a boot disk.

o ESOUND.COM Ver 1.46 or later (c)*Error15

Enables coexistence of EMS and FM sound boards.

- (1) Operates in tandem with ERCACHE. Please use them together whenever possible.
- (2) If an FM sound board (PC-9801-26K/73/86/compatible) is equipped and the FM sound ROM has been detached, ESOUND control may be necessary.
While rarely needed for recent games, caution is required for N88-BASIC(86).
- (3) If you are unsure about BIOS-ROM management, please use ESOUND.
Without ESOUND, ERCACHE may not operate normally.

o ERCGSV.EXE Ver 3.01 or later (c)*Error15

Saves image data captured into memory via ERCACHE's image capture feature to DOS files.
Requires an 80386 CPU or higher.

o WSS118.COM (c)Ankodama

Assists in initializing the PC-9801-118 and coexisting with internal WSS sound cards.

--- Chapter 2: Quick Start Guide ---

What was your motivation for downloading this program?
Most likely, you wanted to make your games run more smoothly...

Whether you take the time to set up ERCACHE or just play the game normally—the choice is yours.

2.1 ERCACHE Basic Operation Mode

All executable files related to ERCACHE must be placed either in the current directory or in a directory specified in your PATH environment variable.

The executables required for basic setup are ERCACHE.EXE, HSB.EXE, and ESOUND.COM (if an FM sound board is present).

To pass commands to the overall ERCACHE system, specify options with the controller executable `ERCACHE.EXE`. If options are omitted, ERCACHE.EXE will automatically determine and apply the optimal default values.

2.2 Boot Disk

You can create a dedicated floppy disk (hereafter "Boot Disk") to boot ERCACHE.

To create a boot disk, you need at least one MS-DOS formatted 1.2MB-type floppy disk. 1.44MB-type disks cannot be used.

First, format the disk using MS-DOS's `FORMAT.EXE`:

```
Y:\>FORMAT H:      ← The drive to format in this example is H:
Format Version 5.50
Insert a new diskette into drive H:
and press any key when ready...
```

To generate the boot disk, specify `/BOOT` when executing ERCACHE:

```
Y:\>ERCACHE /BOOT
*** ERCACHE game support system version 3.01 ***
Copyright (C) 1992-2000 by *Error15
```

High Speed Boot controller for 98 Ver 3.7 Copyright (c) 1991-95 Masao
Insert an initialized disk into 2HD drive #1 and press any key.

Verify that the formatted disk is inserted into 1MB-FDD #1, then press a key.
(If you're unsure which key to hit, press the `@` key).

Upon pressing the key, the following message will be displayed and the task finishes:

ERCACHE boot disk has been successfully created.

Boot disks cannot be used as standard MS-DOS disks; it is safest to keep the

disk write-protected during normal use.

Use the boot disk in the same manner as a standard floppy boot:
Power on the computer system, insert the boot disk, and press Reset.
The following prompt will appear:

Swap system disk [Y]

Swap the boot disk with the disk of the software you want to launch, then press `Y`.
That is all that is required.

2.3 Booting via HSB

If you do not prepare a boot disk, HSB.EXE is required for booting.
To use HSB, system configuration details matching your specific hardware
must be saved into HSB.EXE. Detailed instructions are in HSB.DOC, but here
is a brief overview:

First, add the following line to the top of your existing hard disk's CONFIG.SYS:

DEVICE=x:\HSB.EXE VC Y- (where x:\ is the directory containing HSB.EXE)

Once added, reset the machine and boot from the drive containing that CONFIG.SYS file.
If prompted, press "W" to save your environment settings.

When using HSB regularly, muscle memory might cause you to press hotkeys even
while running games or N88-BASIC(86). It can be frustrating if the hotkeys do not respond.
Therefore, starting from ERCACHE Ver 2.02, HSB hotkeys have been integrated
so they can be used even outside MS-DOS environments.

Let us try running it. Prepare an MS-DOS floppy disk whose CONFIG.SYS does NOT
load `HSB.EXE`, and insert it into the FDD. Then, run ERCACHE.EXE:

```
Y:\>ERCACHE
```

```
*** ERCACHE game support system version 3.01 ***
```

```
Copyright (C) 1992-2000 by *Error15
```

```
High Speed Boot controller for 98 Ver 3.7 Copyright (c) 1991-95 Masao
```

```
High Speed Boot controller for 98 Ver 3.7 Copyright (c) 1991-95 Masao
```

The FDD access indicator light will turn on, and MS-DOS will boot after disk access.
An easy way to test the cache is by running the internal `COPY` command twice:

```
A>COPY /B *.* NUL
```

Run it twice and confirm that the access lamp does not turn on during the second run.

Once you confirm the cache is working, return to the hard disk environment by pressing the hotkey combination: [CTRL] + [GRPH] + [DEL] simultaneously.

Did you successfully return?

Going forward, simply insert the target software's floppy disk and execute ERCACHE.EXE to run your games or programs.

2.4 Configuration Examples

ERCACHE defaults are set up so that it works out-of-the-box without needing options, but depending on your system setup, adjusting parameters may yield better results.

2.4.1 MS-DOS

Running without options is generally fine. However, loading memory management software such as MELEMM.SYS can corrupt the system. In systems where EMS is available, using ERCACHE as a disk cache offers little benefit.

Under MS-DOS, use dedicated disk cache drivers like MELCACH1.SYS/MELCACH2.SYS. If memory is low, moving device drivers to UMB can free up conventional RAM.

Note: Unless specifically designed for games, avoid using freeware caches when playing games.

2.4.2 N88-BASIC(86)

If an FM sound card or internal sound chip is present and the FM sound ROM is detached, configuration is necessary. Incorrect settings can cause boot failures or hangups.

Specify `/ER` if needed. Use `/MON-` if memory is consumed by an extended monitor, `/HIDEDEV` if memory is lost attempting to detect hard drives, or `/NONDP2` if sound fails to play.

2.4.3 Falcom Games

Running games using their bundled cache tools poses no issues. When using ERCACHE, you may need to configure the game side to "Do Not Auto-Detect" protected memory. Many games that failed to run on Ver 2.09 or earlier now work properly under Virtual 86 mode.

2.4.4 MEGDOS

Some titles require the GDC to be set to 2.5MHz to run properly; specifying `/IGDC2` is recommended.

2.4.5 ADDOS

Some titles require the GDC to be set to 2.5MHz; specifying `/IGDC2` is recommended. Since ADDOS performs I/O on a sector-by-sector basis, do not unnecessarily specify `/BASIC-`.

2.4.6 Sword Dancer (SwordDancer)

Sword Dancer requires complex settings, so a dedicated switch is provided. Specifying `/SWORD` automatically applies the optimal disk cache configuration.

2.4.7 Ningyou Tsukai (Doll Puppeteer)

Requires `/DOUBLE`.

2.4.8 Madou Monogatari

Requires `/HM`. Because this game utilizes the HMA region, it cannot be run in 286/386 Protected Memory mode. When using EMS mode on a PIO-PC34 board, set the board switch configuration to "EMS Dedicated".

2.4.9 Wizardry

Runs exclusively under Virtual 86 mode.

2.4.10 Puyo Puyo

If not using Virtual 86 mode, specifying `/IGDC2` is sufficient. When running under Virtual 86 mode, performance heavily depends on machine speed. On systems lacking internal high-speed expansion RAM (e.g., PC-9801VX, PC-286V), specifying `/HS` or `/HS=7` may allow it to run.

--- Chapter 3: Boot Disk Creation Feature ---

As introduced in Chapter 2, creating a boot disk is one method of running ERCACHE. Supplementary details regarding boot disks are provided below.

3.1 Overview

Using a boot disk provides the following characteristics:

- o HSB is not required (though HSB remains very convenient)
- o Can work on systems unsupported by HSB

- o Boots quickly because MS-DOS is not loaded
- o Changing configuration settings requires re-creating the boot disk

3.2 Boot Disk Options

When creating a boot disk, you must specify one of the following options. These can also be combined with standard operational options.

/BOOT (equivalent to /BOOT1)
 /BOOTd Create boot disk using 1MB-type FDD unit #d (d: 1–4)

3.3 Boot Disk Limitations

Boot disks carry several restrictions (and fewer built-in features).

Any ERCACHE features that depend directly on HSB cannot be used when booting from a boot disk.

3.3.1 Cx486 Control Parameter Restrictions

HSB control parameters `/CX=`, `/CXD=`, `/CXI=`, and `/CXB=` cannot be used with boot disks. Specifying them will cause system malfunctions.

When using a boot disk, combine one of `/CX`, `/CXD`, `/CXI`, or `/CXB` with `/CCRn=` or `/NCRn=` as necessary. See Chapter 9 for details.

3.3.2 Compatibility with I-O Data "IPL Disk"

Operating tools that configure Cx486 cache regions (such as "IPL Disk") alongside ERCACHE may result in system instability or failure.

3.3.3 Disk Swapping Restrictions

ERCACHE cannot be loaded twice into memory. Ensure you swap the boot disk out before pressing `Y` at the prompt.

--- Chapter 4: Disk Cache System Features ---

ERCACHE is primarily a disk cache system. This chapter outlines the disk caching functionality built into the core of ERCACHE.

4.1 Overview

General disk caching concepts are assumed knowledge and omitted here. Because ERCACHE is OS-agnostic, it must meet higher operational standards than standard MS-DOS caches. While some software may be incompatible, compatibility efforts continue.

4.1.1 Target Disk Drives

Designed for 1MB-type FDDs. Media dimensions do not matter; 8-inch drives are supported. Dual-mode FDDs are supported only when set to the 1MB interface mode. Unsupported drives pass through directly to the ROM DISK-BIOS. SASI, SCSI, and IDE drives can be configured to be bypassed entirely. 1.44MB-type drives are not supported.

4.1.2 Supported BIOS Commands

Supported BIOS commands include double-density READ DATA, WRITE DATA, and VERIFY. Actual physical I/O occurs only when requested sectors are missing from the cache buffer. READ ID command emulation can also be enabled. Up to track 163 is supported, making disks using over-tracking fully cacheable.

4.1.3 Flushing the Cache

When a disk is removed, the system sounds a buzzer (can be disabled) and flushes all tracks for that drive if cached data existed. Non-cached commands that might affect cache integrity (e.g., READ DELETED DATA or single-density commands) trigger a flush of the affected tracks. If an execution error occurs during a supported command, processing stops and the affected track is flushed. The INITIALIZE command flushes all tracks across all drives.

4.1.4 Hotkey Cache Control

Controlling the cache via hotkeys is convenient. ERCACHE provides an optional global cache toggle across all drives. Specify `/HOT` to enable the following key actions:

Pressing [CTRL] + [GRPH] + [CLR] simultaneously disables caching on all drives and flushes the cache memory. Combine with `/DSWAP` to start with caching disabled at boot time.

Pressing [CTRL] + [GRPH] + [HELP] simultaneously enables caching on all drives. This re-enables caching for drives disabled at boot via `/DSWAP` or disabled via hotkey; drives defined as excluded targets remain excluded.

4.2 Disk Cache Parameters

`/BASIC-` Disables disk read-ahead mode. By default, single-sector slow I/O triggers read-ahead operations. Some games may require disabling read-ahead.

`/DOUBLE` Enables double-buffer mode. Doubles memory allocation per track, enabling caching for disks with track capacities exceeding 8KB. Requires ~3MB per drive; limited effectiveness on low-memory systems.

`/MOTOR-` Enables motor control. PC-9801UX and later 1MB interfaces automatically stop the motor after a set duration. Motor shutdown mimics disk swapping, reducing cache efficiency. ERCACHE disables motor shutdown by default; use this switch if motor control is required.

`/NOFLUSH` Retains cache contents upon disk swap. Added in Ver 2.07, this option is intended for extended single-disk operations on hardware supporting motor control. Drives on PC-9801FA and later models maintain continuous head-to-media contact; continuous motor operation can cause wear. Combined with ``/MOTOR-``, this option preserves cache data even after the motor powers down. Manually flush the cache via hotkey immediately after swapping disks.

`/CDd` Excludes 1MB-type FDD unit #d from caching (d: 1–4). Use when a drive is a RAM disk or requires exclusion.

`/BEEP-` Disables the buzzer sound during disk swaps.

`/DSWAPd=n` Disables caching on 1MB FDD unit #d until n swaps occur (d: 1–4, n: 1–127). Caching can also be manually re-enabled using hotkeys.

`/DRIVE=dddd` Remaps 1MB FDD drives (each d: 1–4). Default mapping is equivalent to ``/DRIVE=1234``. To swap drives #3 and #4 with #1 and #2, specify ``/DRIVE=3412``. Do not use this setting on RAM drives. Has no effect on ``/DSWAPd=n``.

`/SEEK` Forces a physical head seek operation even on cache hits. Generally unnecessary under standard conditions.

`/DUMMY13` Calls INT13 even on cache hits. INT13 acts as the I/O completion interrupt for 1MB FDDs. Generally unnecessary under standard conditions.

`/RIDRd=n` Sets return value R for READ ID commands on 1MB FDD unit #d (d: 1–4, n: 1–15).

When a READ ID request occurs, the system skips physical access and returns sector number R as n. C and H retain call values; N uses the ``/RIDN`` setting.

`/RIDNd=n` Sets return value N for READ ID commands on 1MB FDD unit #d (d: 1–4, n: 1–15).

Returns sector length N as n without disk access. C and H retain call values; R uses the ``/RIDR`` setting.

`/SWORD` Launches "Sword Dancer". Equivalent to specifying:
``/IGDC2 /DUMMY13 /RIDN1=3 /RIDN2=3 /RIDN3=3 /RIDN4=3``

`/HOT` Enables hotkey cache control. Required when using ``/NOFLUSH``.
Note: Default behavior changed in Ver 2.08.

`/KEYTRAP` Enhances keyboard input interrupt monitoring. Some software with custom keyboard handling disables ERCACHE's key trap; this option helps maintain control.

`/STACK` Prevents using local stack inside the Disk BIOS. ERCACHE normally redirects the stack internally during Disk BIOS execution. Requires sufficient stack space from the calling application.

`/HIDEDEV` Disables SASI, SCSI, and IDE devices to prevent corruption when accessing large storage media from older BASIC or DOS boot floppies.

`/HIDEIDE` Disables IDE and SASI devices for system stability on legacy software.

`/HIDESASI` Disables SASI and IDE devices. Prevents errors and preserves usable N88-BASIC(86) memory when hard drives are detected.

`/HIDESCSI` Disables SCSI devices. Prevents errors and preserves usable N88-BASIC(86) memory when hard drives are detected.

`/MON` Enables the extended monitor.

`/MON-` Disables the extended monitor. On newer PC-98 models, portions of the machine-language monitor were removed from N88-BASIC(86) to save space, controlled via Memory Switch 6. These switches configure this behavior.

--- Chapter 5: EMS Mode Memory Management ---

ERCACHE supports 4 operating modes depending on how expanded memory is managed. While modes can be explicitly specified via command-line options, auto-detection evaluates conditions in the following priority order:

- (1) No Protected Memory present → EMS Mode
- (2) CPU is 80286 → 286 Protected Memory Mode
- (3) All other hardware → Virtual 86 Mode

Force EMS mode by specifying `/E`.

In EMS mode, system memory utilizes the EMS region of hardware EMS boards like the EMJ/PIO-PC34 series. EMS and protected memory cannot be managed simultaneously. ERCACHE takes exclusive control of the expanded memory space; it cannot coexist with other software attempting to access the same memory pool.

The system common area at `0:401` is set to 0, ensuring compatibility with software that checks this location before allocating protected memory.

5.1 Overview

EMS mode relies on hardware EMS boards. Because EMS is a software specification, hardware implementations vary. While MS-DOS uses EMM drivers, ERCACHE operates independently of DOS and cannot use device drivers, limiting universal board compatibility.

ERCACHE directly supports widely used expansion boards, including the EMJ series and PIO-PC34 series.

In EMS mode, ERCACHE uses memory space `C0000–CFFFF`:

- `C0000–C3FFF`: EMS page swapping
- `C4000–CBFFF`: Main program body
- `CC000–CFFFF`: FM Sound BIOS

EMS mode offers the highest operational stability among all modes when using ERCACHE as a disk cache. For expansion slot memory additions, Melco EMJ series boards are recommended (excluding newer EMJ-S models).

5.2 EMJ Series

The EMJ series offers multi-mode operation (EMS, Protected, and Bank memory).

Hardware specifications for the EMS region are as follows:

- Page Frame: `C0000–DFFFF` (16KB steps)
- Page Windows: 8 active windows (Hardware registers define 16, but only 8 are usable)
- I/O Ports: `6xEE / 6xEF / 7xEE / 7xEF`
- Note: If a PCI-SCSI board is installed, I/O ports `6000–60FF` are occupied; reassign the EMJ I/O ports to avoid conflicts.

Recommended hardware settings for EMJ series boards:

- o 8086 / V30 / V33 CPU systems → Bank + EMS Mode
- o 80286 or higher CPUs → Protected + EMS Mode

Setting the board to "EMS Dedicated" offers maximum stability for ERCACHE, as few programs directly manipulate hardware EMS registers.

Note: The RAM disk software `EDSK` (c) Dagaya, *Error15, Masao supports direct EMJ control.

5.3 PIO-PC34 Series

The PIO-PC34 series provides flexible EMS, Protected, and Bank memory configurations. EMS hardware specifications:

Page Frame: `C0000–DFFFF` (16KB steps)

Page Windows: 16 active windows

I/O Ports: `00E8 / 00E9 / 00EA / 00EB`

Refer to the PIO-PC34 user manual for optimal hardware switch settings. Setting the board to "EMS Dedicated" provides maximum system stability.

Note: The RAM disk software `PDSK` (c) Dagaya supports direct PIO-PC34 control.

5.4 EMS Mode Options

/E Forces EMS Mode.

/ER Disables FM Sound BIOS shadowing (see Chapter 12).
Prevents EMS allocation to `CC000–CFFFF`.

/UMB=D000 Allocates EMS RAM to `D0000–D3FFF` (16KB block).

/UMB=D400 Allocates EMS RAM to `D4000–D7FFF` (16KB block).

/UMB=D800 Allocates EMS RAM to `D8000–DBFFF` (16KB block).

/UMB=DC00 Allocates EMS RAM to `DC000–DFFFF` (16KB block).

Maps EMS RAM into Upper Memory Blocks (UMB). ROM checking is bypassed; verify memory map manually before setting.

/W2 Enables wait-state control on EMJ page frames (80286+ CPUs).
Increases EMS memory access speed by 20–30%. Because ERCACHE resides within the EMS address space, performance gains are substantial.
See MELWARE `DRIVER.DOC` for technical details.

/BEMJ- Excludes EMJ Bank+EMS configurations from ERCACHE management.

Prevents conflicts when using software reliant on bank memory alongside multiple EMS boards. Do not use if no protected memory or dedicated EMS board exists.

/PEMJ- Excludes non-EMS regions on EMJ Protected+EMS configurations.
Prevents conflicts with software requiring protected memory.
Memory above 15MB remains accessible.

/HM Excludes HMA regions on EMJ Protected+EMS configurations from management, preserving 4 pages for HMA-compliant applications.

/PARITY Disables parity check handling, preventing system halts caused by uninitialized memory reads.

--- Chapter 6: Protected Memory Mode ---

ERCACHE includes 4 operating modes determined automatically or set manually:

- (1) No Protected Memory present → EMS Mode
- (2) CPU is 80286 → 286 Protected Memory Mode
- (3) All other hardware → Virtual 86 Mode

Force Protected Memory Mode by specifying `/V`.
Uses protected memory as system expansion RAM. Compatible with all 80286+ CPUs regardless of motherboard manufacturer.

6.1 Overview

ERCACHE resides in the HMA region (`100000–107FEF`) and assumes control over all protected memory. It cannot coexist with other tools claiming the same memory pool. Memory location `0:401` is zeroed out for software compatibility.

Incompatible with applications that malfunction when HMA is active or software conflicted by local stack placement in HMA. Use EMS Mode or Virtual 86 Mode instead. Note: `CC000–CFFFF` cannot be mapped to RAM in this mode; ESOUND FM BIOS shadowing (Chapter 12) is unsupported.

Due to updates in Virtual 86 and EMS modes, Protected Memory Mode is legacy; use alternative modes whenever possible.

6.2 286 Protected Memory Mode

Default operating mode for 80286 processors. Switching to protected mode normally required a CPU reset to return to real mode. ERCACHE uses undocumented CPU instructions to return to real mode without full resets, accelerating operations.

6.3 386 Protected Memory Mode

Available on 80386+ processors. Allows returning to real mode without CPU resets while leveraging 32-bit instructions for high-speed memory access.

6.4 Protected Memory Mode Options

`/V` Forces Protected Memory Mode.

`/ER` Disables FM Sound BIOS shadowing (see Chapter 12).
Use when an FM sound card is installed without an onboard sound ROM.

`/RET5F0` Sets 286 Protected Memory workspace to RS-232C (CH-1).

`/RET5F4` Sets 286 Protected Memory workspace to RS-232C (CH-2).

286 Protected Memory Mode requires a work area during mode transitions. Default location is 3 bytes at `00560` (RS-232C CH-0). Use these switches to relocate the workspace to CH-1 or CH-2 if CH-0 is used by peripherals.

`/PARITY` Disables parity check monitoring, ignoring uninitialized RAM read errors.

--- Chapter 7: Virtual 86 Mode ---

ERCACHE features 4 memory modes, auto-detected in this priority order:

- (1) No Protected Memory present → EMS Mode
- (2) CPU is 80286 → 286 Protected Memory Mode
- (3) All other hardware → Virtual 86 Mode

Force Virtual 86 Mode by specifying ``/V86``.

Requires an 80386 or higher CPU; unsupported on 8086, V30, V33, and 80286 processors.

7.1 Overview

In Virtual 86 Mode, ERCACHE splits into two components:

1. Virtual 86 Monitor: Resides in protected memory (`110000–13FFFF`) and manages memory.
2. Main Program: Operates in memory space `C0000–CFFFF`, matching EMS Mode layout.

Incompatible with other software using Virtual 86 Mode or protected memory.

Instructions requiring ring 0 access may cause the Virtual 86 Monitor to halt execution.

High-speed internal RAM expansion is strongly recommended for optimal performance.

7.2 Virtual 86 Mode Options

7.2.1 Basic Options

`/V86` Forces Virtual 86 Mode (optional).

`/ER` Disables FM Sound BIOS shadowing (see Chapter 12).

`/PARITY` Disables parity error monitoring.

`/INT86` Directs the Virtual 86 Monitor to invoke ERCACHE directly without modifying interrupt vectors. Useful if software validates vector tables.

`/HS` Accelerates Virtual 86 Monitor operation at the cost of stability.
Can fix distorted software PCM audio playback. Use with caution.

`/HS=n` Relocates Virtual 86 Monitor to memory bank n (n: 0–7) to leverage high-speed internal RAM on upgraded systems (e.g., PC-286V or PC-9801VX with Cx486SLC upgrades). Use with caution.

`/NOTE16` Converts 16-color analog palette (from 4096 colors) to 8-shade monochrome dithering for monochrome LCD laptop displays. Screen flickering may occur.

`/NOTE8` Applies simplified palette conversion for 8-shade monochrome LCD laptop displays.

`/KEYSWAP=ab` Remaps key scan codes (a: original hex code, b: target hex code).

`/400LINE` Forces line doubling for 200-line PC-8800 series compatibility modes, eliminating dark scanlines on 400-line high-resolution displays.

`/CRT31` Forces 31kHz horizontal sync timing adjustments for software requiring 24kHz modes, allowing display on standard 31kHz PC monitors without hardware strain.

/VDS- Disables Virtual DMA Services (VDS / INT 4B). May resolve operational issues.

/GCOL8 Emulates DIPSW1-8 OFF setting (Digital Palette Mode), freeing memory in applications like N88-BASIC(86).

/GPAL Enables read capability for color palette I/O ports (`A8`, `AA`, `AC`, `AE`).
Not required on PC-H98 or PC-9821 series hardware.

/GPLANE Enables read capability for graphics bank I/O ports (`A4`, `A6`).
Not required on PC-9821 series hardware.

/RESETX Configures the power button to act as a system reset button on late-model PC-9821 systems (e.g., PC-9821Xa13 late revision) lacking hardware reset switches.

7.2.2 Memory Allocation Options

/HM Enables HMA I/O control for memory space `100000–10FFFF`. Mandatory for HMA-dependent applications.

/M=a-b Maps RAM into UMB address space from bank a to b ($a \leq b$, $0 \leq a, b \leq FF$).
Example: `/M=A6-A7,D0-DF,E8-F3`.

/SW1 Relocates BIOS-ROM space (`D0000–DFFFF`, max 12KB) to `A5000–A7FFF`, freeing contiguous memory in UMB. RAM disk BIOS and IDE HDD BIOS cannot be moved.

/BANK Enables legacy bank memory control.

/BANK=n Emulates Virtual 86 Bank memory up to n banks (n: 1–255).

/HIDE2- Prevents hiding the main ERCCACHE resident memory block (`C4000–CBFFF`).

/OVER16=n Manually defines memory size above the 16MB boundary (n: 1–254 MB) when pre-existing EMM drivers report incorrect memory capacity.

7.2.3 Audio Options

/TRAPSOUND Monitors FM Sound and MPU-PC98II I/O ports to introduce wait cycles.
/TRAPSOUND=n (Default n=1). Targets ports `188`, `18A`, `18C`, `18E`, `E0D0`, `E0D2`.

/TRAPFM Monitors FM Sound I/O ports (`188`, `18A`, `18C`, `18E`) to introduce wait cycles.

/TRAPMPU98 Monitors MPU-PC98 I/O ports (`E0D0`, `E0D2`) to introduce wait cycles.

/SWAPFMP=n Remaps I/O ports `18x` to address `n8x` (n specified in decimal).

Example: `/SWAPFMP=2` redirects port `18x` accesses to port `28x`.

Requires port `18x` interrupt set to INT5.

/MIXFMP=n Mirrors audio I/O commands sent to port `18x` to secondary port `n8x`, enabling dual sound board playback.

/JOYFMP=n Remaps joystick I/O from port `18x` to secondary sound board at `n8x`.

/EPSON86 Disables access to I/O port `A460` to resolve hardware detection conflicts on EPSON PC-286/386 systems and select PC-98 models.

/STEREO=xxx Converts mono FM audio output (PC-9801-26K commands) to stereo channel mappings (Left, Right, Center) on PC-9801-73/86 hardware.
Example: `/STEREO=LCR`.

/RSMIDI Emulates MPU-PC98 interface over RS-232C serial connections. Supports UART mode and RESET commands. Compatible with EMU-232C and SC-55mkII.

/SBMIDI Emulates MPU-PC98 interface using SoundBlaster16 MIDI ports (Data: `80D2`, Cmd/Status: `81D2`).

/SBMIDIU Alternative SoundBlaster16 MPU emulation mode to prevent system hangups.

/SBMIDI2 SoundBlaster16 MPU emulation mode utilizing interrupt INT1.

/118MIDI Emulates MPU-PC98 interface using PC-9801-118 MIDI hardware (requires non-PnP mode).

/VMPU Emulates MPU-PC98 timing commands using interval timers.

Option Selection Summary:

Standard MPU-PC98 Hardware: (No options)

Hardware MPU (UART mode only): (No options)

RS-232C MIDI (UART mode): /RSMIDI

SoundBlaster MIDI (UART mode): /SBMIDI

PC-9801-118 MIDI (UART mode): /118MIDI

Hardware MPU (Full Emulation): /VMPU

RS-232C MIDI (Full Emulation): /RSMIDI /VMPU

SoundBlaster (Full Emulation): /SBMIDI /VMPU

PC-9801-118 (Full Emulation): /118MIDI /VMPU

7.2.4 Execution Monitoring Options

`/TRAP5F` Monitors delay I/O port ``005F`` to clear prefetch queues and normalize speed.

`/TRAP5F=n` (Default `n=1`).

`/TRAPIO=a-b` Monitors custom I/O port range ``a`` to ``b`` (hex).

Ports ``0002``, ``000A``, ``FFFE``, ``FFFF`` cannot be trapped.

`/TRAPALL` Monitors all I/O ports (equivalent to ``/TRAPIO=0-FFFF``). Use with caution.

`/PTRAP=a-b` Monitors memory writes to page range ``a`` to ``b`` to control execution speed.

Example: ``/PTRAP=A8-BF,E0-E7``.

`/WAITP=n` Inserts `n` wait loops during trapped I/O operations (`n`: 1–32767).

`/WAITR=n` Inserts `n` wait loops during hardware interrupts (`n`: 1–32767).

`/WAITI=n` Inserts `n` wait loops during software interrupts (`n`: 1–32767).

`/TRAPGDCT` Monitors Master GDC I/O ports (``0060``, ``0062``) to adjust text layer timing.

`/TRAPGDCG` Monitors Slave GDC I/O ports (``007C``, ``007E``, ``00A0``, ``00A2``) for graphics timing.

`/TRAPMOUSE` Monitors mouse port ``7FD9`` to stabilize polling in older games.

`/WAITCRTV=n` Inserts `n` wait loops during CRTV interrupts (`n`: 1–32767).

`/SPEEDTIMER` Controls timer interrupt frequency to accelerate games via hotkeys:

Speed Up (max 16x): `[CTRL] + [GRPH] + [SHIFT] + [Up Arrow]`

Slow Down (min 1x): `[CTRL] + [GRPH] + [SHIFT] + [Down Arrow]`

`/SPEEDCRTV` Controls CRTV interrupt frequency via hotkeys:

Speed Up (max 16x): `[CTRL] + [GRPH] + [Up Arrow]`

Slow Down (min 1/16x): `[CTRL] + [GRPH] + [Down Arrow]`

`/ROSE` Applies custom ``/SPEEDCRTV`` adjustments specifically tuned for the game "Rose".

ERCACHE integrates closely with HSB.EXE to manage boot state and system control.

8.1 Launching from MS-DOS

Launching bare-metal software directly from MS-DOS requires specialized handling:

- o Must exit active Virtual 86 / EMS environments (e.g., MELEMM.386).
- o Must reset hardware devices and memory state to post-RESET conditions.
- o Must return execution control back to ERCACHE post-initialization.

HSB satisfies these requirements via its `EXEC` parameter mode.

8.2 Hotkey Rebooting

ERCACHE embeds HSB reboot routines into memory, allowing full system reboots via key combination: [CTRL] + [GRPH] + [DEL].

Alternatively, opening and closing the floppy drive door while holding both mouse buttons triggers a system reboot.

HSB module loading methods:

8.2.1 Resident Driver: Automatically detects resident HSB device driver settings.

8.2.2 File Export: Loads reboot parameters from `ERCACHE.HSB` (created via `HSB WHERCACHE.HSB`).

8.3 Rebooting within Virtual 86 Mode

Pressing [CTRL] + [GRPH] + [INS] reboots the system while maintaining the Virtual 86 Monitor in memory. Note: Disk cache functions are suspended upon rebooting using this mode.

8.4 HSB Options

/HSB- Disables HSB hotkey reboot integration.

/IGDC2 Initializes Slave GDC to 2.5MHz at boot.

/IGDC5 Initializes Slave GDC to 5.0MHz at boot.

/IGDC2:24 Initializes Slave GDC to 2.5MHz and CRT horizontal sync to 24kHz.

/IGDC2:31 Initializes Slave GDC to 2.5MHz and CRT horizontal sync to 31kHz.

/IGDC5:24 Initializes Slave GDC to 5.0MHz and CRT horizontal sync to 24kHz.

/IGDC5:31 Initializes Slave GDC to 5.0MHz and CRT horizontal sync to 31kHz.

/IGDC- Bypasses Slave GDC initialization.

/IEMJ- Bypasses EMJ initialization during HSB execution (prevents PCI-SCSI conflicts).

/SWAP Prompts for a disk swap after HSB system setup.

8.5 Supplementary HSB Parameters

Key HSB parameters referenced by ERCACHE:

IEMJ Closes EMJ EMS windows.
I34 Closes PIO-PC34 EMS windows.
I26 Mutes PC-9801-26/73/86 sound cards.
IGDC... Initializes GDC hardware settings.
IMPU98 Mutes MPU-PC98 MIDI hardware.
IEMU232 Mutes serial EMU-232C MIDI hardware.

--- Chapter 9: Cx486 / 80486 Cache Control Features ---

ERCACHE and HSB provide hardware L1 cache management for Cyrix Cx486SLC/DLC upgrade processors and standard 80486 CPUs.

9.1 Overview

Cyrix Cx486 upgrade processors enhance PC-98 performance, but require explicit software instructions to enable internal L1 cache on legacy motherboards. ERCACHE controls internal CPU cache registers during execution, allowing high-speed operations under N88-BASIC(86) and bare-metal games.

9.2 Hotkey Cache Toggling

Enable hotkey cache management by specifying `CXHOT`.
By default, cache is disabled at boot to ensure compatibility with strict loader routines.

Enable Cache: [CTRL] + [GRPH] + [ROLLUP]
Disable & Flush: [CTRL] + [GRPH] + [ROLLDOWN]

Controls cache state via the `CD` bit in CPU Register `CR0`.

9.3 Cx486 / 80486 Cache Parameters

`/CX` Enables Cx486 cache management via HSB CXP routines.
Disables caching for address range `80000–FFFFF` on boot disks by default.

`/CX=".."` Passes custom configuration parameters directly to HSB `ICX[..]`.

`/CXD` Enables Cx486 cache control with active DMA bus monitoring.
Flushes cache memory automatically when DMAC transfer operations occur.

`/CXD=".."` Passes custom parameters to HSB `ICX[..]` in DMA monitoring mode.

`/CXI` Flushes L1 cache upon exiting INT1B interrupt handlers (equivalent to HSB CXZ).

`/CXI=".."` Passes custom parameters to HSB `ICX[..]` in INT1B flush mode.

`/CXB` Flushes L1 cache during INT1B execution using the CPU `AHOLD` signal (BARB control).

`/CXB=".."` Passes custom parameters to HSB `ICX[..]` in BARB control mode.

`/CX-` Disables all Cx486 cache initialization during boot.

--- Chapter 10: Screen Capture Feature ---

In Virtual 86 mode, ERCACHE can capture graphic display data to system memory in real time and export it to DOS files using the separate utility `ERCGSV.EXE`.

10.1 Overview

Features:

- o Captures Digital 8-color, Analog 16-color, and 256-color screen modes.
- o Saves captured data into standard MAG or 256-color BMP file formats.
- o Operating hotkeys:
 - [CTRL] + [GRPH] + [RETURN] : Trigger Screen Capture
 - [CTRL] + [GRPH] + [SPACE] : Toggle Graphic Layer Display (ON/OFF)

10.2 Image Saver Utility Options (ERCGSV.EXE)

ERCGSV [options] [filename]

Options:

- /B Saves 256-color screen captures in BMP format instead of MAG format.
- /M Forces MAG format output for 256-color images.
- /400 Forces 400-line resolution mode when saving images.
- /200 Forces 200-line double-scanned resolution mode when saving images.
- /DIR=path Specifies the target directory path where captured images are saved.
- /DEL Deletes saved image buffer data from RAM after exporting to disk.

--- Chapter 11: MIDI Emulation Feature ---

Virtual 86 mode includes an MPU-PC98II hardware emulation engine, enabling external MIDI sound modules to function without requiring dedicated expansion cards.

11.1 Overview

Supported hardware and connection pipelines:

- o Standard PC-9801-118 MPU ports
- o RS-232C Serial Port (configured for SC-55mkII or EMU-232 mode)
- o SoundBlaster16 MIDI interface

Controls timing commands via hardware interval timers to maintain proper playback speed. Refer to Section 7.2.3 for command-line switch combinations.

--- Chapter 12: FM Sound Generator Support Features ---

ERCACHE includes options to manage FM audio hardware environments, resolve port conflicts, and enhance legacy sound output.

12.1 Overview

Primary capabilities:

1. FM Sound BIOS Shadowing:
Shadows legacy FM sound board ROM code (e.g., PC-9801-26K/73/86) into RAM space `CC000–CFFFF` via ESOUND.COM, enabling software audio routines to execute when physical ROMs are detached.
2. I/O Port Swapping & Mirroring:
Redirects legacy port `18x` accesses to alternate hardware ports (e.g., `28x`) or mirrors output across multiple sound cards simultaneously using `/SWAPFMP` and

`/MIXFMP`.

3. Pseudo-Stereo Conversion:

Converts monaural FM commands targeting PC-9801-26K chips into 3-channel stereo pan assignments (Left, Center, Right) on 86-compatible hardware using `/STEREO=xxx`.

--- Chapter 13: Command Line Options Summary ---

A comprehensive list of command-line switches available in ERCACHE.EXE:

Boot Disk Creation:

- /BOOT Creates an ERCACHE boot disk in Drive #1.
- /BOOTd Creates an ERCACHE boot disk in Drive #d (1–4).

Disk Cache Parameters:

- /BASIC- Disables read-ahead sector caching.
- /DOUBLE Enables double-buffer mode for tracks larger than 8KB.
- /MOTOR- Prevents FDD motor auto-shutdown.
- /NOFLUSH Retains cache contents across disk swaps (requires /HOT).
- /CDd Excludes Drive #d from disk caching (1–4).
- /BEEP- Disables the disk swap alert buzzer.
- /DSWAPd=n Suspends caching on Drive #d for n disk swaps.
- /DRIVE=dddd Remaps physical FDD drive order.
- /SEEK Forces physical head movement on cache hits.
- /DUMMY13 Forces Disk BIOS INT13 execution on cache hits.
- /RIDRd=n Sets sector ID R return values for READ ID commands.
- /RIDNd=n Sets sector length N return values for READ ID commands.
- /SWORD Applies predefined settings optimized for "Sword Dancer".
- /HOT Enables global hotkey cache toggling.
- /KEYTRAP Enforces keyboard interrupt vector hooks.
- /STACK Bypasses internal stack redirection during Disk BIOS calls.
- /HIDEDEV Disables SASI, SCSI, and IDE drive detection.
- /HIDEIDE Disables IDE device detection.
- /HIDESASI Disables SASI device detection.
- /HIDESCSI Disables SCSI device detection.
- /MON Forces inclusion of the N88-BASIC extended monitor.
- /MON- Excludes the N88-BASIC extended monitor.

Memory Modes:

- /E Forces EMS Mode.
- /V Forces Protected Memory Mode.
- /V86 Forces Virtual 86 Mode.

EMS Mode Parameters:

/ER Disables FM Sound BIOS RAM shadowing (`CC000–CFFFF`).

/UMB=xxxx Maps EMS RAM into UMB space at specified address (`D000`, `D400`, `D800`, `DC00`).

/W2 Enables wait-state control on EMJ page frames.

/BEMJ- Excludes EMJ Bank+EMS configurations.

/PEMJ- Excludes EMJ Protected+EMS configurations.

/HM Reserves HMA pages for external software.

/PARITY Ignores RAM parity check errors.

Protected Memory Mode Parameters:

/RET5F0 Sets 286 Mode workspace to RS-232C CH-1 (`005F0`).

/RET5F4 Sets 286 Mode workspace to RS-232C CH-2 (`005F4`).

Virtual 86 Mode Parameters:

/INT86 Invokes ERCACHE routines without altering interrupt vectors.

/HS Enables high-speed monitor mode.

/HS=n Relocates Virtual 86 Monitor to memory bank n (0–7).

/NOTE16 Applies 8-shade dithered mono conversion for 16-color displays.

/NOTE8 Applies simplified palette conversion for 8-shade mono displays.

/KEYSWAP=ab Remaps key scan code `a` to `b`.

/400LINE Forces 200-line modes to scan-double to 400 lines.

/CRT31 Forces 31kHz display timing adjustments.

/VDS- Disables Virtual DMA Services (INT 4B).

/GCOL8 Emulates Digital Palette Mode (DIPSW1-8 OFF).

/GPAL Enables reading color palette I/O ports (`A8`, `AA`, `AC`, `AE`).

/GPLANE Enables reading graphics bank I/O ports (`A4`, `A6`).

/RESETX Maps power button to act as system reset on select PC-9821 models.

/M=a-b Maps RAM into UMB address space from bank `a` to `b`.

/SW1 Relocates BIOS-ROM space (`D0000–DFFFF`) to `A5000–A7FFF`.

/BANK Enables legacy bank memory support.

/BANK=n Sets Virtual 86 Bank memory cap to `n` banks (1–255).

/HIDE2- Exposes the main ERCACHE memory block (`C4000–CBFFF`).

/OVER16=n Manually defines memory allocation size above 16MB boundary.

/TRAPSOUND Enables I/O wait monitoring on FM and MPU-PC98 ports.

/TRAPFM Enables I/O wait monitoring on FM ports (`188`, `18A`, `18C`, `18E`).

/TRAPMPU98 Enables I/O wait monitoring on MPU ports (`E0D0`, `E0D2`).

/SWAPFMP=n Remaps audio I/O ports `18x` to address `n8x`.

/MIXFMP=n Mirrors audio I/O port `18x` output to port `n8x`.

/JOYFMP=n Remaps joystick I/O from port `18x` to secondary sound board at `n8x`.

/EPSON86 Blocks access to I/O port `A460` on EPSON and select PC-98 systems.

/STEREO=xxx Converts mono FM output to stereo channel assignments.

/RSMIDI Emulates MPU-PC98 interface over RS-232C serial connection.

/SBMIDI Emulates MPU-PC98 interface via SoundBlaster16 MIDI ports.

/SBMIDIU Alternative SoundBlaster16 MPU emulation mode.
 /SBMIDI SoundBlaster16 MPU emulation mode using interrupt INT1.
 /118MIDI Emulates MPU-PC98 interface using PC-9801-118 MIDI hardware.
 /VMPU Emulates MPU-PC98 timing commands via interval timers.
 /TRAP5F Monitors delay I/O port `005F`.
 /TRAPIO=a-b Trap-monitors custom I/O port range `a` through `b`.
 /TRAPALL Trap-monitors all I/O ports (`0–FFFF`).
 /PTRAP=a-b Monitors memory writes across page range `a` through `b`.
 /WAITP=n Sets wait loop count during trapped I/O operations (1–32767).
 /WAITR=n Sets wait loop count during hardware interrupts (1–32767).
 /WAITI=n Sets wait loop count during software interrupts (1–32767).
 /TRAPGDCT Monitors Master GDC I/O ports (`0060`, `0062`).
 /TRAPGDCG Monitors Slave GDC I/O ports (`007C`, `007E`, `00A0`, `00A2`).
 /TRAPMOUSE Monitors mouse port `7FD9` to stabilize polling.
 /WAITCRTV=n Sets wait loop count during CRTV interrupts (1–32767).
 /SPEEDTIMER Enables hotkey control over system timer interrupt frequency.
 /SPEEDCRTV Enables hotkey control over CRTV interrupt frequency.
 /ROSE Applies CRTV timing adjustments optimized for "Rose".

HSB System Control Options:

/HSB- Disables HSB reboot integration.
 /IGDC2 Initializes Slave GDC to 2.5MHz.
 /IGDC5 Initializes Slave GDC to 5.0MHz.
 /IGDC2:24 Initializes Slave GDC to 2.5MHz and CRT sync to 24kHz.
 /IGDC2:31 Initializes Slave GDC to 2.5MHz and CRT sync to 31kHz.
 /IGDC5:24 Initializes Slave GDC to 5.0MHz and CRT sync to 24kHz.
 /IGDC5:31 Initializes Slave GDC to 5.0MHz and CRT sync to 31kHz.
 /IGDC- Bypasses Slave GDC initialization.
 /IEMJ- Bypasses EMJ board initialization during reboot.
 /SWAP Prompts for disk swap post-initialization.

Cx486 Processor Options:

/CXHOT Enables hotkey control for CPU L1 cache.
 /CX Enables standard Cx486 cache management.
 /CX=".." Passes custom configuration parameters to HSB `ICX[..]`.
 /CXD Enables Cx486 cache control with DMA bus monitoring.
 /CXD=".." Passes custom DMA parameters to HSB `ICX[..]`.
 /CXI Flushes L1 cache upon exiting INT1B routines.
 /CXI=".." Passes custom INT1B parameters to HSB `ICX[..]`.
 /CXB Flushes L1 cache during INT1B using CPU `AHOLD` signal.
 /CXB=".." Passes custom BARB parameters to HSB `ICX[..]`.
 /CX- Disables Cx486 cache initialization at boot.

--- Chapter 14: Hotkeys Summary ---

Global Hotkey Reference:

System Reboot (HSB Mode):

- [CTRL] + [GRPH] + [DEL] : Perform full system reboot
- [CTRL] + [GRPH] + [INS] : Reboot system while maintaining Virtual 86 Monitor
- [Left Mouse] + [Right Mouse] : Open and close drive door while holding both mouse buttons to trigger system reboot

Disk Cache Control:

- [CTRL] + [GRPH] + [CLR] : Disable disk caching on all drives & flush buffers
- [CTRL] + [GRPH] + [HELP] : Enable disk caching on all drives

Cx486 / L1 Cache Control:

- [CTRL] + [GRPH] + [ROLLUP] : Enable CPU L1 Cache
- [CTRL] + [GRPH] + [ROLLDOWN] : Disable & Flush CPU L1 Cache

Execution Speed Adjustments:

- [CTRL] + [GRPH] + [SHIFT] + [Up] : Increase Timer Interrupt Speed (up to 16x)
- [CTRL] + [GRPH] + [SHIFT] + [Down] : Decrease Timer Interrupt Speed (down to 1x)
- [CTRL] + [GRPH] + [Up] : Increase CRTV Interrupt Speed (up to 16x)
- [CTRL] + [GRPH] + [Down] : Decrease CRTV Interrupt Speed (down to 1/16x)

Image Capture (Virtual 86 Mode):

- [CTRL] + [GRPH] + [RETURN] : Capture active screen to RAM buffer
- [CTRL] + [GRPH] + [SPACE] : Toggle Graphic Layer Display (ON/OFF)

--- Chapter 15: Revision History ---

- 1992/08/17 Ver 1.00 : Initial public release.
- 1993/02/10 Ver 1.50 : Added EMS memory mode support.
- 1994/05/22 Ver 2.00 : Introduced 386/486 Protected Memory mode support.
- 1995/11/03 Ver 2.50 : Implemented Virtual 86 Monitor and extended UMB controls.
- 1997/08/12 Ver 2.80 : Added MPU-98 MIDI emulation and SoundBlaster support.
- 1999/04/01 Ver 3.00 : Extended graphics capture functions and Cx486 cache hooks.
- 2000/05/20 Ver 3.01 : Fixed bug in 31kHz CRT sync handler; optimized 118 MIDI timing.

--- Chapter 16: Closing Remarks & Credits ---

ERCACHE is freeware distributed under standard non-commercial evaluation terms.
Redistribute in original, unmodified archive form.

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- o WSS118 : (c) Ankodama
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Address bug reports, feedback, and hardware operational logs to PC-VAN: CQF15666
(*Error15).