SuperRAM

Installation Guide

& User's Reference

Creative Micro Designs, Inc.

CMD SuperRAM
Installation Guide & User's Reference

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General Information

The CMD SuperRAM card is an add-in card for the CMD SuperCPU 64 and SuperCPU 128 accelerator cartridges. This card will allow the addition of 1, 4, 8 or 16 Megabytes of RAM which the 65816 processor of the SuperCPU can directly address. A single SIMM (Single Inline Memory Module) socket on the SuperRAM circuit board provides this expandability using standard 72-pin fast-page mode SIMM modules.

Uses

The additional memory provided on the SuperRAM card requires custom programming in 65816 code. At this time, there is no easy way for BASIC programmers and general users to make old programs work with this extra memory. CMD has provided patches that allow GEOS to use up to 2 MB of RAM from the card, and has other projects planned that will use expanded RAM. However, other programs will need to be modified or written by programmers to provide additional usefulness. A number of developers have indicated that they do have programs in development to help fill this need.

Important Power Requirements

CMD recommends the use of a heavy duty power supply on all C-64 or 64C computers equipped with a SuperCPU. The extra power required by the SuperCPU surpasses Commodore's maximum current specification for the cartridge port, and the addition of the SuperRAM card further increases the load placed on the computer's power supply. Warning: Using the stock Commodore power supply under these conditions may not only cause your computer to function improperly, it may also cause permanent damage to your equipment. If you need a heavy-duty supply, you may order one by contacting the CMD order desk at 1-800-638-3263 (Mon.—Fri., 9AM—5:30PM EST). If you're calling from outside the United States or Canada, the number to call is 413-525-0023.

The Utilities Disk

We have included a replacement for the SuperCPU Utilities disk that contains additional programs for testing, using and developing for the SuperRAM card. Please be aware that these programs are covered under international copyright law, and may not be redistributed without permission from the copyright owners. For additional information on these programs, see the Utilities Disk section of this manual.

Installation

Installation

To install a SuperRAM card into your SuperCPU, use the steps that follow. *Please note that static electricity can damage the circuit boards you will be handling, so it is wise to use an anti-static wrist strap and take any other possible precautions to avoid static discharge. If you feel you aren't capable of performing the installation, contact CMD for rates on professional installation.*

Step 1: Before installing the SuperRAM card, turn off your computer and all peripherals, and remove the SuperCPU from your computer's cartridge port.

Step 2: Remove the four (4) screws that hold the case together (two on each side—see figure a).

Step 3: Separate the two halves of the case so that you have full access to the circuit board in the lower half. The upper half is easier to remove from the bottom half if you angle it slightly, then work it up off the switches at the top (see figure b).

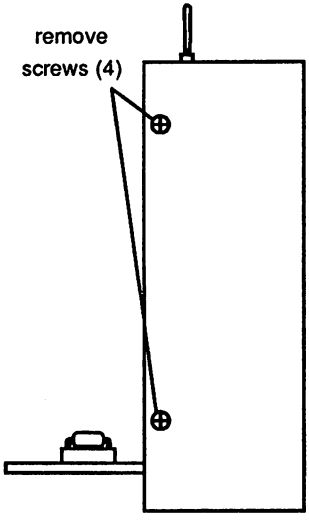


figure a

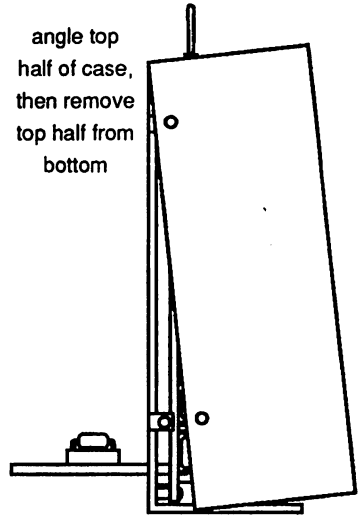


figure b

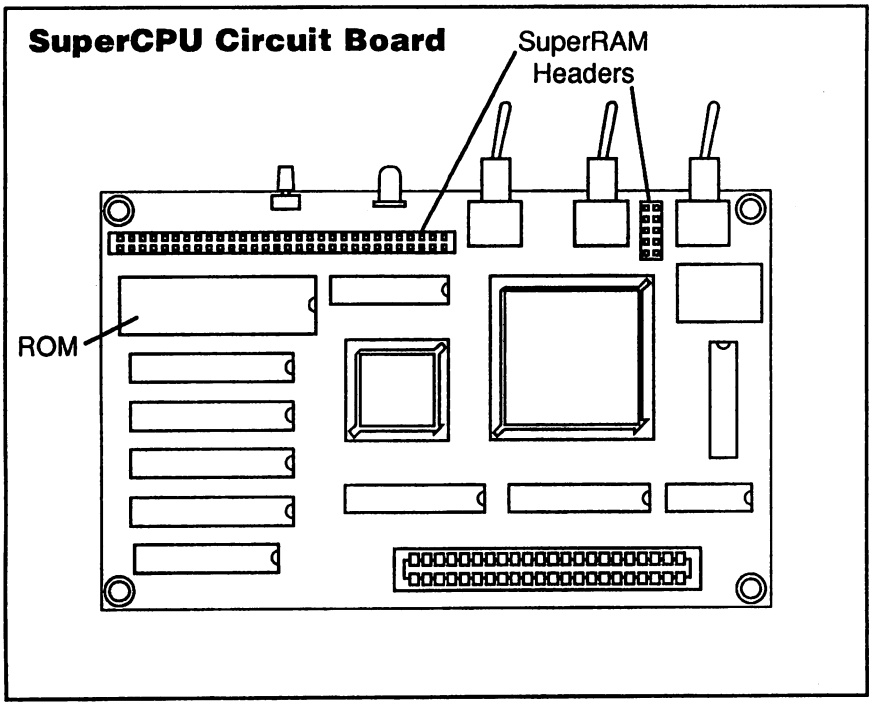


figure c

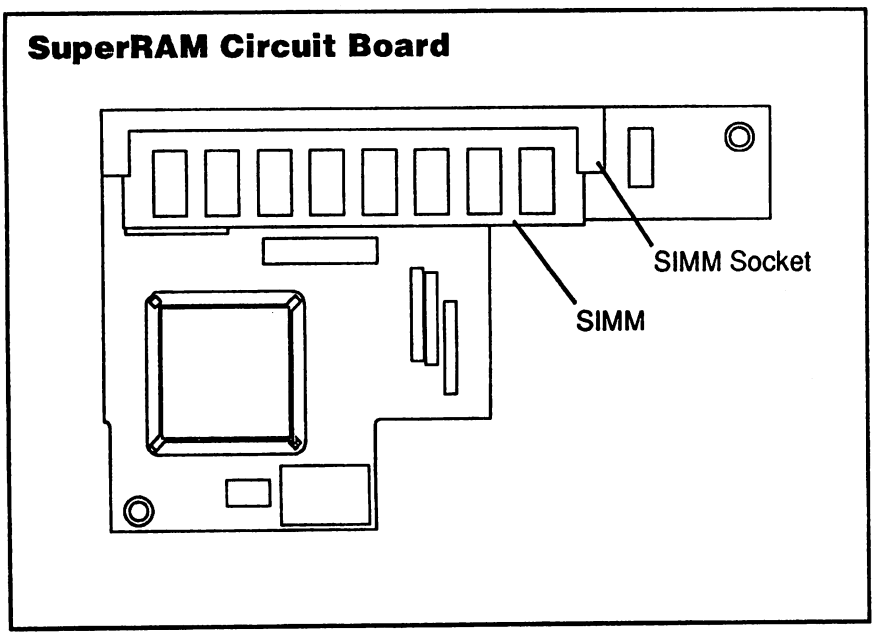


figure d

Step 4: If your SuperRAM card came with an upgrade ROM, then remove the old ROM from the SuperCPU main board (see figure c), and replace it with the new one. You may use either a chip remover or a small flat blade screwdriver to remove the old chip from its socket. Make sure that you note the proper orientation of the chip and that you insert the new one correctly. Also make sure you have all the pins aligned with the socket before you firmly press the new chip into place.

Step 5: If you intend to install your own SIMM in the SuperRAM card, you should do so before moving on to the next step. The location of the SIMM socket on the SuperRAM card is indicated in figure d. Note: 72-pin SIMMs are notched and can only be installed one way.

Step 6: To install the SuperRAM card onto the SuperCPU main board, you must align the two connectors on the back of the SuperRAM card with the mating headers on the SuperCPU, then firmly press the two boards together. Refer to figure e.

Step 6: Re-assemble your SuperCPU.

Your SuperCPU with SuperRAM card is now ready to use, and should display the amount of extra memory found when you start your computer. However, before proceeding further, we recommend that you run the SUPERRAMTEST program included on the SuperCPU Utilities disk (see the section entitled *The Utilities Disk* for instructions). This program will verify that your SuperRAM card is fully functional. If you have any problems with the operation of your unit, refer to the *Troublshooting* section of this manual for assistance.

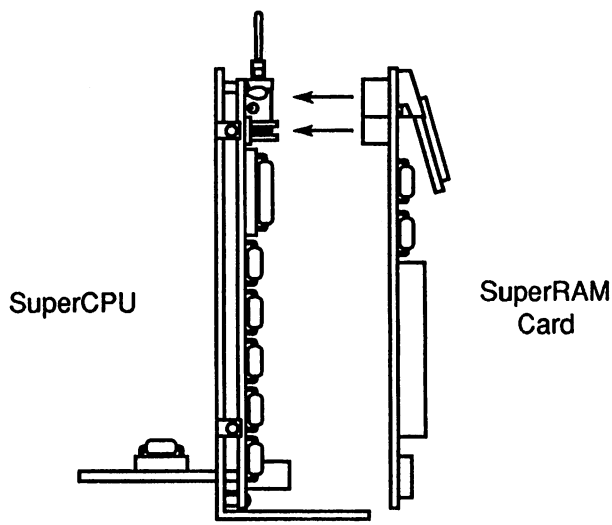


figure e

Troubleshooting

After you have installed and tested the SuperRAM card, you may discover that your unit is not working correctly. The information included here should assist you in either fixing the problem yourself, or in determining that the unit needs to be serviced by CMD.

Please note that if your unit exhibits problems running specific software with the SuperRAM card installed, please do the following:

- Remove any items installed in the SuperCPU cartridge port and re-test. If the problem persists, move to the next step. If the problem goes away, there may be a conflict between the cartridge port device and the software, or your computer may not be able to handle the additional load—see *Low Voltage Conditions* and *Bus Loading/Noise Conditions*. Also, verify whether the device should work with the software, and if it should, test on a different computer if possible.
- Remove the SuperRAM card and try the software again. If the fault persists at this point, see the Troubleshooting Tips in the SuperCPU User's Guide. If the problem goes away without the SuperRAM card installed, re-install the SuperRAM card and re-test. If the problem returns, check the items listed below.

Dirty Contacts or Bad Connections

Many problems are connection-related, and can often be resolved by the user. The following items should be checked:

- Make sure the SIMM is properly seated (try re-installing it)
- Make sure the SuperRAM card itself is properly seated
- Check the cartridge port connector to make sure that its contacts line up well along the slot opening, and that they are clean and free from foreign substances. If necessary, align and clean the contacts (you can pick up contact cleaning spray from most electronic suppliers, such as Radio Shack).
- Check the SuperCPU's edge connector to make sure the contacts are clean and free from foreign substances. Clean if necessary.

Low Voltage Conditions

If for some reason your power supply cannot provide the additional power required by the SuperRAM card, the supply voltage may drop and cause unusual problems. Make sure you are using a heavy duty supply (if using a Commodore 64). If you have the technical skills, test the power supply voltage with the SuperCPU and SuperRAM card attached to your

computer. The supply voltage should be +5 volts. Some slight variance is normal, but if the voltage is less than 4.8 volts your power supply may be faulty or inadequate.

Bus Loading/Noise Conditions

Some Commodore computers simply cannot handle having too many things attached to their cartridge port. This may be due to weak bus signals, or to high levels of electrical noise on address, data or control lines. This can create a myriad of symptoms, from screen artifacts (odd characters on the screen where they shouldn't be) to complete failure of the machine to operate. If you suspect you have a loading or noise problem, try to clean and tighten any connections to reduce noise. If this doesn't resolve the problem, try installing your SuperCPU/SuperRAM on a different machine to localize the problem. If you don't have a different machine to try it on, you may want to contact CMD's repair service about troubleshooting the problem for you (this is usually a last resort, since it requires sending the computer and SuperCPU/SuperRAM to CMD for evaluation).

SuperCPU/SuperRAM Incompatibility

Some SuperCPU units prior to Revision 1E may not be compatible with the SuperRAM card. This is mainly due to loading characteristics of certain parts that were used in these units. The problem can cause a number symptoms, such as program freezes, unexpected drops to the BASIC prompt, failure of the SuperCPU to initialize, SRAM failure messages, failure of the SuperRAM Test program, and unexplained resets. CMD has devised an upgrade for the SuperCPU 64 CPLD (Complex Programmable Logic Device) chip that compensates for this problem. If you have a SuperCPU previous to Revision 1E and have tried to resolve symptoms such as those described above without success, you should contact CMD directly about the possibility of needing this upgrade.

SIMM Information

The SuperRAM card contains only a few components: a clock oscillator, bus driver, a reprogrammable array logic device (GAL), a digital delay chip, a complex programmable logic device (CPLD), and a handful of resistors and capacitors. There are also two connectors on the back of the circuit board (not shown) which attach the SuperRAM card to the SuperCPU main board, and a 72-pin SIMM (Single Inline Memory Module) socket where the RAM SIMM is installed. As with the SuperCPU itself, the SuperRAM card's complex circuitry is mostly inside the CPLD, which contains most of the memory mapping, control and refresh circuitry.

The SIMM socket can be fitted with 72-pin memory modules containing from one to 16 Megabytes of standard Fast Page DRAM. It's very important to make sure that the SIMM used is standard Fast Page; EDO and other 72-pin SIMM types are not compatible, and will not operate correctly. The memory must be rated at 70 ns or faster (the lower the number, the faster the speed rating). Please note that faster RAM doesn't translate into better performance; the DRAM controller has fixed speeds for performing memory access.

For information on compatible SIMMs, see the SIMM Support Information below. The chart defines all SIMMs approved for use with the SuperRAM card.

SIMM Support Information

This chart indicates the size and organization of 72-pin SIMMs supported by the SuperRAM card for the SuperCPU. All SIMMs must be Fast Page Mode type, 70ns or faster.

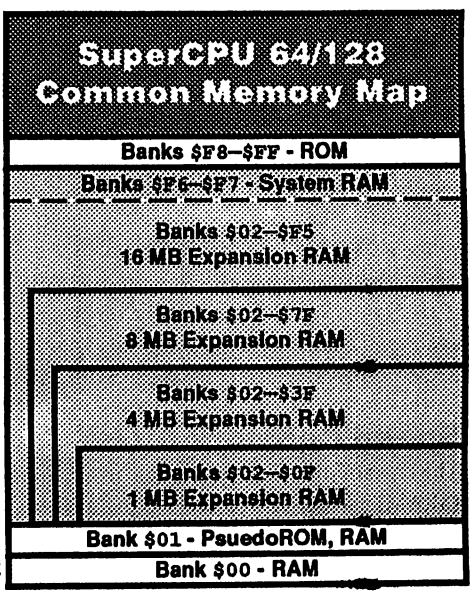
SIMM Capacity	Organization	Row Size	Row/Column Adr.
1 MB	256K x 32/36	2 KB	9/9
4 MB	1M x 32/36	4 KB	10/10
8 MB	2M x 32/36	4 KB	10/10
8 MB	2M x 32/36	4 KB	11/10
16 MB	4M x 32/36	4 KB	11/10
16 MB	4M x 32/36	4 KB	12/10
16 MB	4M x 32/36	8 KB	11/11

SuperRAM Programming Information

Since the 65816 processor can address up to 16 Megabytes of RAM, the SuperRAM memory is unlike previous RAM expanders (such as the Commodore and CMD 17xx series REUs or the CMD RAMLink) in that programs can actually execute directly from this memory—provided they are written to do so. It's also important to note that programs don't have to use the 65816 processor's native mode to be able to access this extra RAM (see the Programming Examples).

For a good overview of how the SuperRAM card fits into the SuperCPU memory scheme, take a look at the "SuperCPU 64/128 Common Memory Map" below. The areas in white (Banks $00, $01 and $F8 through $FF) are found in every SuperCPU, with or without memory expansion. Banks $00 and $01 are Static RAM (SRAM), while $F8 through $FF are used by or reserved for system ROM. This map is identical on both the 64 and 128 versions of the SuperCPU. *Note: The SuperCPU 128 has two additional banks of 'hidden' SRAM which are swapped in at Banks $00 and $01 as needed.*

As you can see, there is room for expansion RAM at Banks $02 through $F7. Addressing of installed SIMM memory actually begins at $000000, but since there is Static RAM at these locations, the SIMM RAM Banks $00 and $01 have been moved to Banks $F6 and $F7 (just below the system ROM), and reserved for future system use. Due to this, the highest Bank available for user programs will be Bank $F5 (on a system with 16 Megabytes of expansion RAM installed).



Detecting Expansion RAM

Any SuperCPU sold after the SuperRAM card became available has version of the SuperCPU ROM that supports expansion RAM. Also, users with older versions who purchase SuperRAM upgrades are supplied with the new ROM. Thus, the first step in determining if RAM expansion is present is to check the ROM version. This is accomplished by reading four bytes, beginning at

$00E487 (64 mode only!). These four bytes contain the version number string in PETASCII. The version that will provide initial support for expansion RAM is "1.40". Read these bytes and compare for this number. If the version number is lower, there's no expansion; if it's the same or higher, there may be expanded memory, and you'll need to move on to the next step.

If the first check returns a version that supports RAM expansion, read in four bytes beginning at $00D27C. These bytes contain the following information concerning RAM expansion:

$00D27C First Available Page
$00D27D Bank of First Available Page
$00D27E Last Available Page+1
$00D27F Bank of Last Available Page+1

If there isn't any extra RAM installed, all four bytes will contain zeroes. The BASIC program SUPERRAMDETECT (located on the SuperCPU Utilities disk) provides an example of checking these parameters and calculating the available expansion memory. Please note that these variables are only valid in Bank $00 while I/O is switched in; should you need to check for expansion RAM with I/O out, these values are available in the same locations of Bank $01.

If your application needs to use some portion of expansion RAM, it must also update the memory variables. This requires switching in the SuperCPU H/W registers by storing any value at $00D07E (decimal 53374). After you have modified the variables, turn the SuperCPU H/W registers back off by storing any value to $00D07F (decimal 53375). Again, I/O must be enabled during any of these changes, or you'll need to change the variables directly in Bank $01.

It is very important that you pay attention to the expansion RAM variables, and that you don't make any assumptions with regard to RAM availability; some future system extensions or user programs may steal some of the RAM before your application is started. As a result, it would be wise to create your program code and/or data segments in a manner that allows them to be relocated. CMD is presently working toward standards and tools that will make writing and utilizing relocatable code less painful, but the transition will be easier if programmers start getting familiar with the techniques now.

To assist you in testing routines that detect RAM expansion, we've included the program SUPERRAMFAKE on the SuperCPU Utilities disk. You may use this program to trick your SuperCPU into believing that it has different amounts of RAM expansion available. Naturally you can do this yourself as well by writing bogus values into the RAM pointers, which is what the SUPERRAMFAKE program does.

Speed Considerations

The Dynamic RAM (DRAM) used in SIMMs can't be accessed as fast as the Static RAM (SRAM) used on the SuperCPU main board, but it is far less expensive and available in larger capacities. Lower cost is why DRAM is used for large capacity expansion memory.

When writing programs on the SuperCPU that use expanded memory, performance may sometimes suffer slightly when accessing DRAM. Try to locate routines that must operate quickly in Static RAM in order to better optimize your programs. Also, when accessing DRAM, try to do so sequentially—the SuperRAM memory controller has been optimized for this. Jumping around a lot or performing non-sequential reads is the cause of most slowdowns. Further details about the speed of expansion RAM and other SuperCPU functions is available in an article published in Commodore World magazine, Issue #19 (this information will also appear in the SuperCPU Programmer's Guide).

Programming Examples

The following example shows how 65816 machine language code can easily read and write memory locations above the first Bank (addresses higher than $FFFF). This type of programming requires using new addressing modes in the 65816 microprocessor.

```
; long read from memory
LDA $01D27C        ; LDA long

; long write to memory
STA $01D27C        ; STA long
```

Since pre-existing 6502 assemblers do not support these new addressing modes, you'll need to use some tricks to enter the code. Here's a way to code these on a 6502 assembler:

```
; long read from memory
.BYT $AF           ; opcode for LDA Absolute Long
.BYT $7C,$D2,$01   ; address in low,mid,high format

; long write to memory
.BYT $8F           ; opcode for LDA Absolute Long
.BYT $7C,$D2,$01   ; address in low,mid,high format
```

Both LDA and STA also support long addressing for .X indexed operations, and many other opcodes have long addressing modes available. For a complete list of 65816 opcodes, see "A 6502 Programmer's Introduction to the 65816," Commodore World magazine, Issue #16, pg. 20.

The Utilities Disk

The SuperCPU Utilities disk that has been provided with your SuperRAM card has been updated to contain programs to assist you in testing, using and writing programs for your SuperRAM card. These programs are copyrighted and are for your use only. The following is a list of the disk contents:

```
RUNME.BAS
SuperInstall
calculator
64CONFIG 2.1s
SRBOOT
SUPERRAMTEST
SUPERRAMDETECT
SUPERRAMFAKE
```

The RUNME.BAS program just describes the disk contents, and has been included mainly for SuperCPU owners who don't have the SuperRAM card, and thus do not have this documentation. The SuperInstall utility is thoroughly explained in the SuperCPU manual, and will not be covered in this document.

SUPERRAMTEST

This utility has been created to assist you in making sure that your SuperRAM card is properly installed and fully operational. To load the program, insert the SuperCPU Utilities disk in your floppy drive (device 8) and type:

```
LOAD"SUPERRAMTEST",8
```

Be sure to press the <RETURN> key to complete the command. After the program has loaded, type RUN and press the <RETURN> key.

When the program begins, it will prompt you to make sure that you wish to test the SuperRAM card. Answer yes by pressing the <Y> key, and the test will begin. As the test proceeds, it will first test the memory in your computer that will be used to verify operation of the SuperRAM card. It will then begin testing the SIMM memory installed in the card. As each test is completed, the program will indicate that your unit has passed by placing an OK message next to the test description. The program will use various bit patterns to test the complete memory. This test can take

several minutes, but you should notice that it will change the bit pattern info as the test progresses.

When the test successfully completes, it will display a message to that effect. However, if at any point a failure occurs the test will end, indicating ERROR instead of OK for the status of the particular test that failed. If you get a such a failure, try the troubleshooting steps below before contacting CMD Technical Support.

- If you have any additional cartridge-port hardware attached to your system, remove it and try the test again.
- Re-seat the SuperCPU in your computer's cartridge port and run the test over again.
- If the test fails again, check to make sure the SuperRAM card and SIMM are properly installed, and run the test again.
- If the test still fails, check the alignment of the contacts on your cartridge port, re-align them if necessary, and make sure they are clean. Test again if you found any deficiencies that you have corrected.
- Try testing the SuperCPU on another computer if you have access to one.
- Try testing the SuperRAM card in another SuperCPU if you have access to one

Be sure to take notes on what test the device fails, and what the results were to each of the troubleshooting steps you took. Should you need to contact CMD Technical Support, this information will help speed determination and resolution of the problem. Above all, do not send the unit back to CMD until you have contacted CMD Technical Support for a Returned Material Authorization (RMA) number.

SUPERRAMDETECT

This program serves mainly as an example for programmers to show them how to detect a SuperRAM card installed in a SuperCPU, as well as determine the amount of RAM that is installed in the card.

SUPERRAMFAKE

This utility can be used to modify the RAM registers in the SuperCPU, making it possible to test RAM detection routines for different amounts of RAM. With some slight alterations, it could also be used to place any version string into the area of memory where that is stored (presently the program writes "1.40" to that area). Pressing the reset button on the SuperCPU will return these areas to normal.

64CONFIG 2.1s

This file is only used with the CMD SuperCPU with a populated SuperRAM card installed, and will only work with US or German GEOS 64 v2.0 (this CONFIGURE file will *not* work with any GEORAM version of GEOS). It allows GEOS to use up

to approximately 2 Megabytes of RAM (from the SuperRAM card) to create RAM disks. This version of CONFIGURE also recognizes CMD HD and CMD FD drives, but will *not* recognize a RAMLink or any other RAM device. The recommended steps for replacing your CONFIGURE file are as follows:

- Install your CMD SuperRAM card into your SuperCPU if you haven't already done so
- Patch your GEOS boot disk with SuperInstall to use the SuperCPU if you haven't already done so (see instructions in the SuperCPU manual)
- Boot GEOS with only 1 disk drive (device 8) attached
- Locate the CONFIGURE file on your boot disk
- Center the pointer over the icon for your CONFIGURE program, and click once to select it
- Pause, then click a second time to attach the icon to your pointer
- Move the pointer until it points into the deskTop's bottom border area (between the printer icon and the trash can icon)
- Click once in this area to deposit the CONFIGURE icon into the border
- After the disk activity stops, click once on the CONFIGURE icon to select it again
- Pause, then click a second time to attach the icon to your pointer
- Center your pointer over the trash can and click once
- Remove your GEOS boot disk, and insert the SuperCPU Utilities disk in your drive
- Click once on the drive A icon to open the disk
- Locate and click once on the 64CONFIG 2.1s file icon
- Pause, then click a second time to attach the icon to your pointer
- Move the pointer until it points into the deskTop's bottom border area (between the printer icon and the trash can icon)
- Click once in this area to deposit the 64CONFIG 2.1s icon into the border
- When your pointer reappears and all disk activity has stopped on your disk drive, remove the SuperCPU Utilities disk and insert your boot disk
- Click once on the drive A icon to open the disk
- Click once on the 64CONFIG 2.1s icon (located in the border) to select it
- Pause, then click a second time to attach the icon to your pointer
- Move your pointer until its point is centered over the file note pad area (the area where file icons normally appear)
- Click once in this area to start the file copy procedure
- Follow the prompts provided for disk swaps to complete the copy procedure
- After the procedure is complete, insert the SuperCPU Utilities disk into your drive

Important Note About GEOS and SuperRAM

Since it is possible to re-enter GEOS after exiting to BASIC, GEOS does not free declared memory it uses in the SuperRAM card. If you do not intend to return to GEOS, free the memory by pressing the reset button on the SuperCPU.

- Click once on the 64CONFIG 2.1s file icon located in the border
- Pause, then click a second time to attach the icon to your pointer
- Move the pointer until its point is centered over the file note pad
- Click once to deposit the file icon back onto the file note pad
- Exit from GEOS and turn off your computer

You may now configure your system according to your needs. If you need to, refer to the section *Using More than One Disk Drive* in your GEOS 2.0 manual (pg. 77), and take note of the differences and tips provided below.

- If you use only one physical disk drive, you may have up to two RAM disks
- You may have only one RAM disk if you use two physical drives
- You may not have a RAM disk if you have three physical drives (device numbers 8, 9 and 10), but all three drives can be on the deskTop at once
- While in CONFIGURE (64CONFIG 2.1s), either drive a or drive b *must* be a real (physical) disk drive or you won't be able to exit the program
- If you set up two RAM disks of the same type, be sure to rename one of them immediately, or GEOS could become confused and corrupt one or both
- The *Shadow 1581 Dir* option no longer appears, as the HD/FD version of the 1581 driver does not support this function
- There is no *DMA for MoveData* option, since the SuperRAM doesn't use a DMA controller
- Be sure to save your configuration, and copy this version of CONFIGURE (64CONFIG 2.1s) to other disks you use which contain different versions.

SRBOOT

This file is only used in conjunction with GEOS 64 v2.0 and 64CONFIG 2.1s. SRBOOT lets you reboot GEOS from your RAM, provided you haven't turned your computer off or overwritten the RAM. The recommended steps for replacing your old RBOOT file with SRBOOT are as follows:

- Boot GEOS with only 1 disk drive (device 8) attached
- Locate the RBOOT file on your boot disk
- Center the pointer over the icon for your RBOOT program, and click once to select it
- Pause, then click a second time to attach the icon to your pointer
- Move the pointer until it points into the deskTop's bottom border area (between the printer icon and the trash can icon)
- Click once in this area to deposit the RBOOT icon into the border
- After the disk activity stops, click once on the RBOOT icon to select it again
- Pause, then click a second time to attach the icon to your pointer
- Center your pointer over the trash can and click once
- Remove your GEOS boot disk, and insert the SuperCPU Utilities disk in your drive

- Click once on the drive A icon to open the disk
- Locate and click once on the SRBOOT file icon
- Pause, then click a second time to attach the icon to your pointer
- Move the pointer until it points into the deskTop's bottom border area (between the printer icon and the trash can icon)
- Click once in this area to deposit the SRBOOT icon into the border
- When your pointer reappears and all disk activity has stopped on your disk drive, remove the SuperCPU Utilities disk and insert your boot disk
- Click once on the drive A icon to open the disk
- Click once on the SRBOOT icon (located in the border) to select it
- Pause, then click a second time to attach the icon to your pointer
- Move your pointer until its point is centered over the file note pad area (the area where file icons normally appear)
- Click once in this area to start the file copy procedure
- Follow the prompts provided for disk swaps to complete the copy procedure
- After the procedure is complete, insert the SuperCPU Utilities disk into your drive
- Click once on the SRBOOT file icon located in the border
- Pause, then click a second time to attach the icon to your pointer
- Move the pointer until its point is centered over the file note pad
- Click once to deposit the file icon back onto the file note pad

To use the SRBOOT file, make sure you have the RAM Reboot option selected in CONFIGURE (64CONFIG 2.1s), then exit from GEOS using the BASIC option in the options menu. Insert a disk containing SRBOOT into any active drive and load it. If you were using device 8, you would load the file by typing:

```
LOAD"SRBOOT",8
```

Be sure to press the <RETURN> key to start the load process. When the READY prompt appears, type RUN and press <RETURN>. GEOS will be rebooted from the RAM. This program will only work correctly if (a) your computer's power hasn't been interrupted since you exited GEOS; (b) your devices are set up using the same device numbers as they had when you last exited from GEOS, and (c) nothing has overwritten the GEOS Kernal that resides in the SuperRAM card memory.

calculator

This is an updated version of the calculator desk accessory that is provided with GEOS 64 v2.0. The standard version has a bug that can cause a system crash on accelerated systems when math functions are called. The version supplied here fixes that bug, and should be used to replace your original. This new version will work fine whether you're using acceleration or not. Use standard copying procedures as outlined in your GEOS manual to copy this to your work disks.