

Instructions For



Five Slot Expansion Interface for the C-64™



cardco, Inc.

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CARDBOARD/5 - INSTRUCTION MANUAL
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INTRODUCTION

Please read each step of this instruction manual in order. A few cartridge programs have curiosities you'll want to know about from the start, so that when you see them they won't surprise and confuse you.

Let's start with the simplest applications of "CARDBOARD/5." Once you understand the normal operation, you'll be ready to deal with the variations. Be sure to see the "GLOSSARY" for terms you don't know.

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SECTION A: What is "CARDBOARD/5"?

The "CARDBOARD/5" theory of operation will be explained in more technical detail in the section, ""CARDBOARD/5" THEORY OF OPERATION."

Simply described, the "CARDBOARD/5" is a parallel extension of the Commodore 64's game port. In other words, by using "CARDBOARD/5," you can switch cartridges without physically pulling them out and plugging them in one at a time.

But why all the little switches and lights if all you need are more places to plug cartridges? First of all, there must be some way of turning off the cartridges not being used, to make the computer think there's only one game or program in the game port. If it weren't for the switches, it would be like cramming five game cartridges into the little opening in the back of the 64. The computer would be as confused as you would be if you were trying to play five games at once. Only it wouldn't try; not even on a bet.

Second, the "CARDBOARD/5" does much more than just electronically plug and unplug cartridges. It tells the 64 which memory map to use, that is, what part of it's memory to draw on. This function will be explained in greater detail later.

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SECTION B: INSTALLING THE "CARDBOARD/5"

Enough talk, for now. You're anxious to plug in your cartridges, no doubt. This is the way:

1B. TURN OFF YOUR COMPUTER.

2B. Locate the game port opening in the rear of your C/64.

3B. Remove from the "CARDBOARD/5" any cartridges you've inserted (patience!). With the back of the computer facing you, carefully slide the tab into the game port slot. Careful not to twist the board. Make sure the bottom of "CARDBOARD/5" is flush with the bottom of the computer and that both are on a flat, solid surface.

4B. Refer to figure 1, "CARDBOARD/5"'s picture. Are all of your "CARDBOARD/5" switches in the "OFF" position (pulled toward the back of the computer)?

5B. Begin with slot #5 and work forward to slot #1 (see figure 1). Plug in the cartridges, filling all five slots if you like, and in any order. The labels on the cartridges should face the back of the computer (toward the operator).

NOTE: If you have CP/M or 80-wide column expansion cartridges, begin in slot #1 and work toward slot #5, filling the lower-numbered slots with the CP/M and 80-wide expansion cartridges first. Even the short distance from slot #1 to slot #5 can delay the signal long enough to cause

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problems in these faster programs.

6B. Turn on the 64 computer.

SECTION C: LIGHTS . . . CAMERA . . . ACTION!

Here's what you should see with your cartridges plugged in, all the "CARDBOARD/5" switches off, and power to your computer.

ON YOUR MONITOR SCREEN: the usual message on blue background; "38911 basic bytes free"; "READY."; flashing cursor.

ON YOUR "CARDBOARD/5":

Each slot with a cartridge should have the YELLOW Light Emitting Diode (LED) closest to it lit. This LED is labeled YELLOW 1 in figure 1. If your screen and "CARDBOARD/5" look just as the first paragraph in this section says they should, go on to Section D: NORMAL OPERATION.

If your screen or your "CARDBOARD/5" looks different from what is described above, find in steps 1C through 3C below the best description of what you see and follow the instructions for that step.

1C. SCREEN: NORMAL.

"CARDBOARD/5": NO LEDS ON.

There is no power to the "CARDBOARD/5". Turn off your computer, check the fuse on the "CARDBOARD/5." If the element inside the fuse is broken, replace the fuse. Repeat steps 1B through 6B.

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2C. SCREEN: BLANK except for the blue border (no cursor, no message--just blue).

"CARDBOARD/5": ONE OR BOTH MASTER CONTROL LEDs ARE ON

Make sure all "CARDBOARD/5" switches are turned to "OFF." Now push the square red RESET button on "CARDBOARD/5" (see figure 1).

3C. SCREEN IS NORMAL.

"CARDBOARD/5": YELLOW 2 ON INSTEAD OF YELLOW 1 beside one or more slots. AND YELLOW 1 AND YELLOW 2 BOTH ON beside one or more slots (all switches "OFF", please).

TAKE OUT those cartridges which have lights other than yellow 1 only lit. BUT DON'T WORRY. Those cartridges will work fine, but will require switch positions not discussed in "NORMAL OPERATION." So that you can first understand normal operation, leave only those cartridges which after step 3C have YELLOW 1 LED only lit. Go to Section D: NORMAL OPERATION.

IF NONE OF YOUR cartridges have the right combination of yellow lights on, that's fine, also. You just don't happen to have any cartridges that work with the usual switch configuration. Leave the cartridges plugged in and go to Section E: "Special OPERATION". Otherwise, go to Section D: NORMAL OPERATION.

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SECTION D: NORMAL OPERATION

(This is a test of the CARDBOARD/5's normal operation. Figure 1 will help you to follow these steps.)

Does your "CARDBOARD/5" and screen look the way the first paragraph in Section C says it should? If not, GO BACK to Section C. If they do, you're ready to test the operation of the "CARDBOARD/5" with your cartridge programs.

1D. Choose one of the inserted cartridges you would like to turn on.

2D. Flip both of the switches to the cartridge's right to the "ON" position (see figure 1). Both the green and the red LED to the left of the switches should come on.

3D. Press the square red RESET button on "CARDBOARD/5". The game cartridge is now activated, just as if you had plugged it directly into the game port and turned on the computer. The game should now start. IF IT DOES NOT, GO BACK to the beginning of Section C.

4D. Turn both switches beside the cartridge back to the "OFF" position (figure 1). The screen will probably show some weird pattern. Ignore it, you can't play it.

5D. Push the RESET button. The screen should return to the normal READY message with 38911 bytes free. If it doesn't, press the RESET button again and hold it down for a full second.

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NOTE: You need not press the reset button as in step 5D for normal operation unless you wish to return to your BASIC program. This step is included as a test.

6D. Choose a cartridge in a different slot.

7D. Flip the switches to its right to the "ON" position.

8D. Press the RESET button. The screen should show the "start game" sequence of the game program. If it doesn't, press the RESET button again and hold it down for a full second.

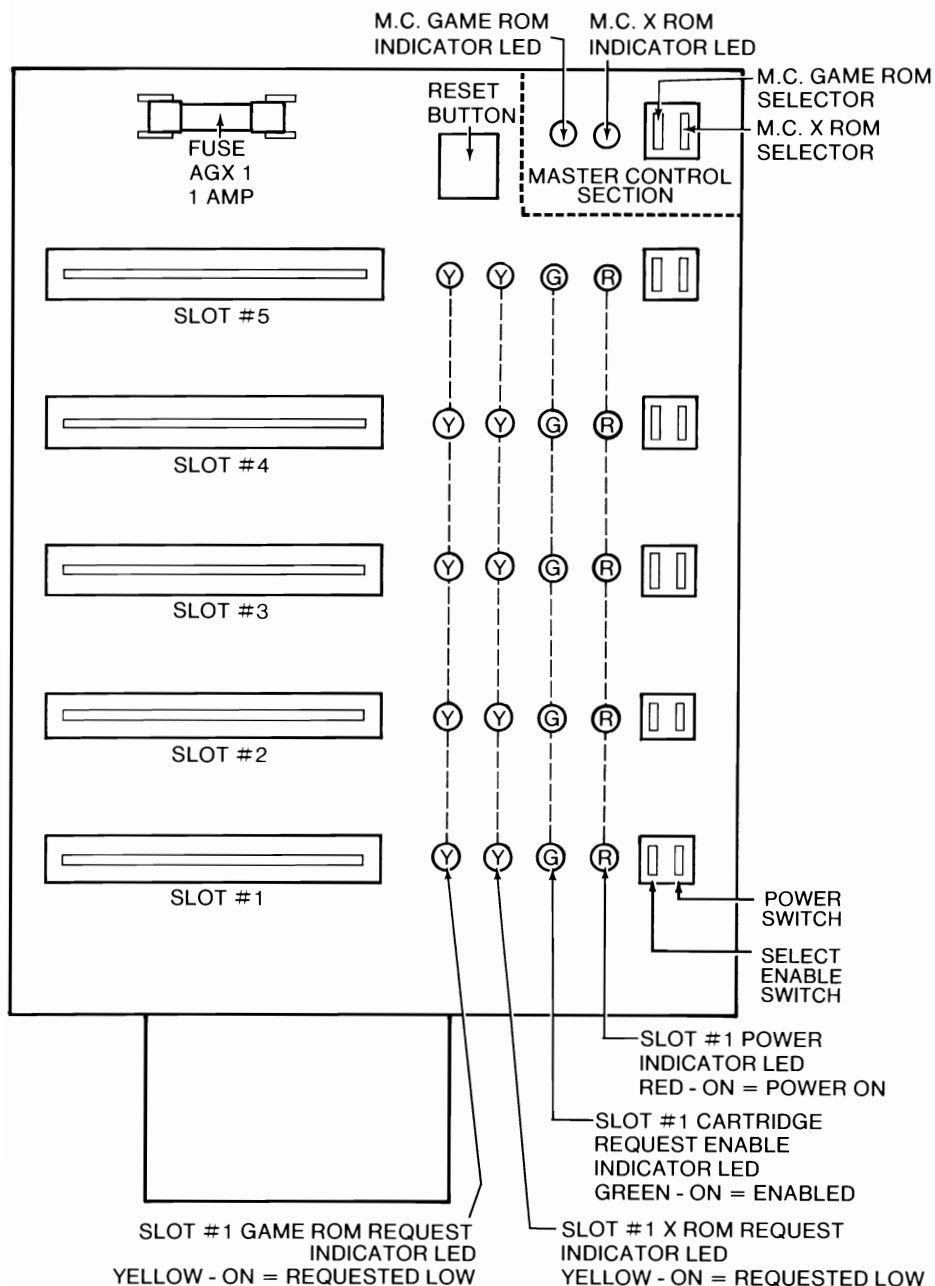
9D. Turn the switches to the cartridge's right to the "OFF" position. Hit the RESET button.

10D. Repeat steps 6D through 9D until all cartridges have been tested.

If any of these steps fail, return to Section C and repeat those steps carefully before returning to Section D. If you still don't get the expected results, call our Customer Service line.

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SECTION E: SPECIAL OPERATION

Some cartridges, both games and other programs, have features which will not allow the "CARDBOARD/5" to operate as described in Section D: NORMAL OPERATION. If all switches on "CARDBOARD/5" are "OFF" and power is applied to the computer, any given game cartridge will turn on one or both of the YELLOW LEDs to its right. If you know how to read the LEDs to the right of the cartridges, you can tell which memory map the cartridge requests. (See Section F: THEORY OF OPERATION for memory maps.)

When cartridges of different types are mixed on the same "CARDBOARD/5" they may affect one another, requiring SPECIAL OPERATION, which means, simply, putting the switches in different positions than in NORMAL OPERATION.

More on that later. First, follow this scenario. THIS COULD BE YOU.

The day Burt bought his "CARDBOARD/5" he hurried home and grabbed his shoe box full of game cartridges. After he had chosen five at random and inserted them into the "CARDBOARD/5", he installed it and turned on his computer. He skipped over the instructions because he was, as I said, in a hurry.

He tried to enable slot #1 under NORMAL OPERATION (by flipping the switches to the right of slot #1 to the "ON" position).

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Instead of the RADAR RAT RACE he had inserted into slot #1, he got the wild blue yonder, no game, no cursor, no message, just blue screen and blue border.

In desperation he returned to the instructions. Then he paid attention to the LEDs beside the cartridge. He noticed that instead of YELLOW 1 alone being lit for each cartridge, both YELLOW 1 and YELLOW 2 were lit, except at slot #3, where YELLOW 1 was off and YELLOW 2 was on.

He made sure all the "CARDBOARD/5" switches were "OFF" and pulled the #3 cartridge from its slot. OMEGA RACE, huh? He looked at "CARDBOARD/5" and found that since OMEGA RACE was unplugged, the slots were back to the way that Section D: NORMAL OPERATION said they should be, with only their YELLOW 1's lit. He left OMEGA RACE unplugged for the time being and tried slot #1 again. Behold--RADAR RAT RACE, just as he wanted in the first place.

He tried the other cartridges and they all worked. When he plugged the OMEGA RACE back in, however, the other games refused to cooperate the way the instructions said they should. But when he flipped both switches beside slot #3, OMEGA RACE worked fine. It worked so well, in fact, that when he turned the switches "OFF", OMEGA RACE kept going. When Burt tried to enable the other cartridges with NORMAL OPERATION instructions, he got only bizarre patterns and ghostly fragments of OMEGA RACE.

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Burt began to think there was something a little odd about OMEGA RACE, and he was right. You may have cartridges that cause the screen and "CARDBOARD/5" to act odd, too. Before you discard them or call in an exorcist, consider this: There are a number of hardware programs out there, game cartridges and others, that use a software program to rewrite the memory map of the computer. A more detailed explanation of this can be found in Section F: "CARDBOARD/5" THEORY OF OPERATION. But to put it in simple terms, most cartridges work as if they have been built right into the computer as a part of its HARDWARE.

Cartridges like Omega Race and some other ULTIMAX video games aren't satisfied with such a simple set-up. They take over part of the computer's memory and use it to run a software program. This program remains even if the cartridge is removed. That's why you can turn the switch off next to Omega Race and it will continue to run. You can play the game with the switches off as long as you don't press the RESET button or turn on another game.

Of course you'll want to be able to use different kinds of cartridges on the same "CARDBOARD/5", and that's what it's designed for. "CARDBOARD/5"'s SPECIAL OPERATION just requires more switch-flipping than its NORMAL OPERATION.

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You may have to use the master control switches (see figure 1) to switch the games. It will help if you know how to read the LEDs. This is explained in Section F: "CARDBOARD/5" THEORY OF OPERATION.

In Burt's case let's say that he had, in addition to RADAR RAT RACE, SEA WOLF, JUPITER LANDER, and THE VISIBLE SOLAR SYSTEM plugged in and everything was working fine. He knew they were all cartridges of similar operation because when the computer was powered up, all these cartridges had their YELLOW 1 LEDs on and their YELLOW 2 LEDs off.

You may have some of these games and probably have some different games and programs as well. Insert them into the "CARDBOARD/5" one at a time, alone, and see which lights to the right light up and write it down. You can do this with power to the computer so long as all "CARDBOARD/5"'s switches are "OFF."

A cartridge that shows YELLOW 1 on and YELLOW 2 should operate like RADAR RAT RACE did in the example. A cartridge that shows YELLOW 1 off and YELLOW 2 on should affect "CARDBOARD/5" the way OMEGA RACE did in Burt's story. Let's look at Burt's situation as an example. Here's how you could use the switches on "CARDBOARD/5" to solve Burt's problem:

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1E. Place OMEGA RACE in slot #5.

2E. To play OMEGA RACE put switches next to slot #5 in following positions:

Slot #5 right switch---"ON" (red light on)

Slot #5 left switch---"ON" (green LED and yellow 2 LED on, yellow 1 LED off)

Master Control Switch 1 (gamerom)----OFF

Master Control Switch 2 (exrom)-----OFF

3E. PUSH RESET.

If OMEGA RACE is plugged into "CARDBOARD/5" with it, RADAR RAT RACE (and all the others like it) will work with the switches in this combination:

Right slot switch-----ON (this puts power onto the cartridge)

Left slot switch-----OFF (both YELLOW LEDs will be on, GREEN LED will be off)

MASTER CONTROL SWITCH 1----ON(gamerom LED will be on)

MASTER CONTROL SWITCH 2----OFF(exrom LED will be off)

PUSH RESET.

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Any of the cartridges that light up as described in the first paragraph of Section C should work with this combination.

Cartridges that turn on the same lights ask for the same memory map from the computer. Therefore, when using the MASTER CONTROL SWITCHES to control them in SPECIAL OPERATION, what works for one cartridge should work for all of that same type.

Solutions to the problem will vary with the number and types of cartridges inserted. There are too many different types of cartridges being produced now--and probably some that haven't been produced yet--and too many possible modes of operation for this manual to give a complete list of switch combinations. Trial and error, that is, trying several combinations of switch positions on each cartridge, may be the easiest method.

After all, there are only six possible switch combinations for any one cartridge. The RIGHT SLOT SWITCH (power to the cartridge) must always be "ON" (RED LED lit) to enable a cartridge. That only leaves three switches to experiment with. When you find the combination that works for one cartridge, the same combination may work for similar cartridges. Remember, this is only one of a thousand possible combinations of cartridges. This is meant only to be an example. Section E: "CARDBOARD/5" THEORY OF OPERATION" is a more general and more technical description of what happens when "CARDBOARD/5"'s switches are flipped.

SECTION F: "CARDBOARD/5" THEORY OF OPERATION

This section will explain why different switch combinations are needed with certain cartridge combinations of cartridges in the "CARDBOARD/5". The reference for this section is the Commodore 64 Programmer's Reference Guide. This is not the same as the Commodore 64 User's Guide, but is more detailed in its explanation of system functions.

The Reference Guide includes memory map configurations. These configurations are controlled by four lines: the LORAM, HIRAM, GAMEROM, and EXROM lines.

Voltages are placed on or removed from these lines to choose different memory configurations--let's call these configurations "maps" as the Commodore 64 Programmer's Reference Guide does.

The computer "looks" at these lines to see which memory map is being requested. The status of these is changed by manipulating a +5 volt potential. Left alone, these lines hold +5 volts. We will use the term "HIGH" to express this condition. If an external device such as a cartridge or a "CARDBOARD/5" switch grounds one of these lines, the +5 volts is removed. This 0 volt condition we call LOW.

If the computer sees +5 volts on all the lines, it operates as usual: 8K BASIC ROM and 8K KERNAL ROM are intact and accessible. If the computer sees 0 volts on any or all of the lines, it changes its memory map.

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For example, in the 64 computer's usual operating status, with 8K of BASIC ROM and 8K of KERNAL ROM intact and accessible, the status of the lines is this:

LORAM = HIGH (+5V on the line.)

HIRAM = HIGH

GAMEROM = HIGH

EXROM = HIGH

The LORAM and HIRAM lines are controlled by software only. You cannot affect them by changing the "CARDBOARD/5" switch positions.

The GAMEROM and EXROM lines you may control with "CARDBOARD/5." These lines are brought out through the game port where "CARDBOARD/5" is inserted.

The GAMEROM and EXROM lines are controlled in two ways. First, the game cartridges control each line by letting it keep its +5 volt charge or by grounding the line, that is, by placing it at 0 volts.

Second, YOU may control the GAMEROM and EXROM lines with the "CARDBOARD/5." Both the MASTER CONTROL SWITCHES and SLOT SWITCHES affect the lines by doing the same thing the cartridges do, creating a LOW or HIGH condition on the line as you choose.

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Remember, the computer continuously looks at these lines. If it sees that the GAMEROM line is HIGH and the EXROM line is HIGH the computer will operate normally; it will not access any external memory (from a game cartridge or anything else.)

The MASTER CONTROL LEDs (see figure 1) tell you what state the lines are in. These LEDs will be referred to hereafter as GAMEROM LED and EXROM LED.

MASTER CONT. LED 1 (left) = GAMEROM line LED

MASTER CONT. LED 2 (right)= EXROM line LED

Here is how to read them:

GAMEROM LED----ON	GAMEROM line----LOW
GAMEROM LED----OFF	GAMEROM line----HIGH
EXROM LED-----ON	EXROM line-----LOW
EXROM LED-----OFF	EXROM line-----HIGH

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Pretty simple, huh? The next step is to translate what the different combinations of these lines mean to the computer. The key to knowing what request is being sent to the computer by the cartridges in the "CARDBOARD/5" is to LOOK AT THE MASTER CONTROL LEDs, NOT THE SWITCHES.

If both a LOW and a HIGH are placed on the same line, the computer will see only the LOW. So if one cartridge asks for GAMEROM LINE HIGH (YELLOW LED 1 off), EXROM LINE LOW (YELLOW LED 2 is on) and another cartridge asks for GAMEROM LINE LOW, EXROM LINE HIGH, the computer would see a LOW on both lines if both cartridges were enabled. You would see both MASTER CONTROL LEDs lit.

Simple arithmetic tells us there are four possible combinations these LEDs may show. More than four different memory maps may result from these combinations, however, because a cartridge or other EXTERNAL DEVICE may use the LORAM and HIRAM lines as well as the GAMEROM and EXROM lines to change the computer's memory. Here are the four possible MASTER CONTROL LED COMBINATIONS:

MC LED COMBINATION 1

GAMEROM LINE = HIGH (GAMEROM LED OFF)

EXROM LINE = HIGH (GAMEROM LED OFF)

THIS MEANS: The computer will operate normally. 8K BASIC ROM and 8K KERNAL ROM are present. The computer will ignore any EXTERNAL memory.

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MC LED COMBINATION 2

GAMEROM LINE = HIGH (GAMEROM LED OFF)

EXROM LINE = LOW (EXROM LED ON)

THIS MEANS: The computer will see 52K of RAM from memory location \$0000 to \$CFFF. And 8K of memory at \$E000, either RAM or KERNAL ROM, depending on the status of the LORAM and HIRAM lines. 4K RAM for I/O devices and routines stays at \$D000. In these memory maps the LORAM and HIRAM lines are, in a manner of speaking, left open to suggestion. It is up to the EXTERNAL device to ask for one map or another by grounding one or the other to LOW.

There is a third map possible under MC LED COMBINATION 2. If the EXTERNAL device places both LORAM and HIRAM at LOW, the computer looks at all 64K RAM at once, meaning it sees no commands, meaning you see a blank screen.

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MC LED COMBINATION 3

GAMEROM LINE = LOW (GAMEROM LED IS ON)

EXROM LINE = HIGH (EXROM LED IS OFF)

THIS MEANS: This switch combination creates one memory map. This map was designed for ULTIMAX game cartridges. Notice that most of the cartridges in Burt's story use this map, with the exception of OMEGA RACE, which requests one of the maps from MC SWITCH COMBINATION 2.

In this map the computer sees no INTERNAL RAM except for 4K from memory location \$0000 to \$0999. The computer will read external ROM or RAM at location \$E000. It will keep the basic interpreter on line at memory location \$A000 and the I/O functions and character generator at location \$C000. A total 16K CARTRIDGE ROM is available, 8K at \$8000 and 8K at \$E000.

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MC LED COMBINATION 4

GAMEROM LINE = LOW (GAMEROM LED IS ON)

EXROM LINE = LOW (EXROM LINE IS ON)

THIS MEANS: The EXTERNAL DEVICE has four possible memory maps to choose from by changing the LORAM and HIRAM lines. If both lines are placed at LOW, the computer looks at all 64K and you look at a blank screen. The remaining maps are as follows:

8K KERNAL ROM at \$E000, 4K for I/O devices at \$D000 and the 4K RAM BUFFER at \$C000. Depending on the request from the EXTERNAL DEVICE, memory location \$8000 may have 8K CARTRIDGE ROM, 8K RAM, or 16K CARTRIDGE ROM.

Once one of these memory maps is acquired, the program can make additional changes in it.

This combination might be used by cartridge programs such as some word processors which don't require BASIC.

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Section G: PARTING SHOTS

*Under NORMAL OPERATION the LEFT SLOT SWITCH (the enable switch) should be in the "ON" position to pass the cartridge's request to the computer. If the GREEN LED by the slot is on, the request is being sent.

In SPECIAL OPERATION, however, the LEFT SLOT SWITCH may have to be "OFF" when one or both of the MASTER CONTROL SWITCHES is "ON", in order to send the right request. If this is the case it's a good idea to turn the LEFT SLOT SWITCH "ON"--at first, anyway--then "OFF", if necessary, to make sure the request gets to the computer.

*The RIGHT SLOT SWITCH (the power switch) must be "ON" (RED LED ON) to enable a cartridge, both in NORMAL OPERATION and SPECIAL OPERATION.

*Cartridges may be inserted and removed when power is on to the computer SO LONG AS THE SLOT POWER SWITCH IS "OFF."

*Certain cartridges have very high power requirements and may need an external power source. You shouldn't run into this unless you're using, for example, an 80-column adapter with a high power requirement in conjunction with another cartridge or cartridges.

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**APPENDIX A: ENABLING MORE THAN ONE CARTRIDGE
IN "CARDBOARD/5" AT ONCE**

You should be familiar with Section D: NORMAL OPERATION and Section F: SPECIAL OPERATION before attempting to read this section.

Once again, examples will work better than general principles here. But first, a general principle.

GENERAL PRINCIPLE: Two programs can't be in the same place at the same time.

But there may be times when you'll want to have more than one cartridge enabled.

For instance, some prefer using an 80-character line to the 64's usual 40-character with their word processors. Naturally, both the 80-column convertor and the word processing program will have to run at the same time.

This is possible only if the two programs are not trying to occupy the same hex location at the same time. In other words, if the 80-column converter occupies \$A0000 and the word processor loads into \$80000, and each takes up no more than 8K, they will probably live peaceably in the same computer. If not, one of the programs will have to be moved to a different memory location. This takes a relocation program.

NOTE: When using some 80-column converters their power requirements can be quite high. It may be necessary to use an external power supply.

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Say, for example, you need an IEEE card to control on of the larger disc drives. At the same time you wish to use a cartridge-based word processing program.

If the IEEE card loads a software program, as some do, it will have to be loaded into a different location than the word processor, as explained above. The card manufacturers usually recognize this and may include a tape program that moves (relocates) the IEEE program to a different memory location. Let's use this as an example of how to use more than one cartridge in the "CARDBOARD/5" at once.

If the instructions that came with the cartridges tell you into which memory locations they load, you'll know immediately whether you'll have to relocate your IEEE program. Otherwise, try enabling them both through the "CARDBOARD/5." Use the instructions for NORMAL OPERATION. BUT do not turn "OFF" the RIGHT SLOT SWITCH for the IEEE or 80-column adaptors after you've enabled them because they may need power to control I/O functions.

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If they crash, you may have to use the relocation program. This is how you would operate the "CARDBOARD/5" in that case:

A-1A. Make sure all "CARDBOARD/5" switches are "OFF." Insert cartridges.

A-2A. Turn both SLOT SWITCHES next to the IEEE card to "ON."

A-3A. Push RESET. Now you've mapped in the IEEE program.

A-4A. Turn the IEEE's LEFT SLOT SWITCH to "OFF" but leave the cartridge inserted and leave the RIGHT SLOT SWITCH (power) "ON."

A-5A. Run the relocation program, following the manufacturer's instructions.

A-6A. Now you can enable the word processing program. Turn both SLOT SWITCHES for the word processing program to "ON."

A-7A. Push RESET OR type: SYS 64738 (This restarts the computer without doing a hardware reset.) You are ready to process words.

"HOLD IT!" you exclaim. Doesn't the RESET erase the other program? Would we let you erase your program? The RESET just resets the pointers; it doesn't erase memory. But you do have the alternative of typing in SYS 64738 to insure that the cartridges stay enabled. Use this if pushing RESET causes a problem.

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With both programs enabled via the "CARDBOARD/5", when your word processor calls in the I/O functions it will go through the IEEE program and card instead of the serial bus.

One more thing: if you try to use a cartridge-based machine language program to disassemble another cartridge program inserted in "CARDBOARD/5," you may have trouble. The cartridge-based monitor will load into the same place any other cartridge would, BASIC ROM OR KERNAL ROM, so there's no moving it. You'll need to use a tape-based or disc-based monitor that loads low in the RAM or that you can move into the RAM.

Once again, these are only examples of solutions and may not work in every case. There are too many different cartridges floating around out there for one instruction manual to account for.

As always, our Customer Service line is at your disposal. If you've followed all the steps in this manual carefully and still aren't getting results, give us a call between 1 PM and 5 PM Central time, Monday thru Friday or write to:

CARDCO, Inc.
313 Mathewson
Wichita, Ks.
67214

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"CARDBOARD/5": A GLOSSARY

Memory Map: The Commodore 64's memory is separated into "blocks," usually of 4K, 8K, or 16K bytes. What kind of memory (RAM or ROM) and how much of it these blocks contain may be altered by software programs and external devices (game cartridges, for example.) "Memory map" is a figure of speech to describe any one of these different arrangements of memory. The Commodore 64 Programmer's Reference Guide shows a complete memory map chart.

Hex location (\$0000 through \$FFFF): The characters behind the dollar sign make up a number. It's a base 16 number, otherwise known as hexadecimal. See your Commodore 64 Programmer's Reference Guide to find out how to convert the numbers into decimal. Each number identifies a one-byte location. For example, we know BASIC ROM starts at \$8000. That means that the first character of the first command for BASIC is found 32,768 bytes away from the lowest byte in RAM, \$0000.

