The
Cuttle Cart

The Atari 2600
Universal Ram Cartridge

from

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of
Schell's Electronics

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The Cuttle Cart!

Thank you for purchasing a Cuttle Cart. Before I go on with the description of how to use the Cuttle Cart, I'd like to give a little background on the name Cuttle Cart.

The Cuttle Cart is named after the marine creature the cuttlefish, which is the animal pictured on the Cuttle Cart label. Cuttlefish are a type of cephalopod, a relative of the octopus and squid. They are amazing animals capable of incredible shifts in both pattern and color, all in the blink of an eye. If I called this cart the Atari 2600 Chameleon, I think people would understand - chameleon because the cart can take on the appearance of other carts. Well, the color and pattern shifting abilities of the cuttlefish far exceed those of the chameleon, so in my opinion, it's an even better choice.

Since I work in oceanography, I couldn't resist the chance to spread the word about these creatures. They're neat, complex little animals with a lot of talent. There is evidence that they use their colors and patterns as a language to communicate with one another, and there are even papers discussing cuttlefish personalities! If you'd like to learn about a very interesting, but under-appreciated animal, I suggest you inquire at your local library or search the internet for more information on cuttlefish.

That's enough about the name, now on with the information on how to use the Cuttle Cart. I hope you enjoy it.

— Chad Schell

Getting Started:

The following is a quick introduction on how to use the Cuttle Cart to play games on an Atari 2600. Detailed specifications on loading games into the Cuttle Cart, the Cuttle Cart's native bankswitching format, and the original Supercharger bankswitching format can be found in the programmer's section.

Requirements:

Cuttle Cart
Atari 2600 or 100% Compatible. (NOT RECOMMENDED FOR USE IN THE ATARI 7800!)
Audio Player - Such as a CD player, cassette player or computer with sound card.
Games - Such as those provided on the included *Stella Gets a New Brain* CD.

Using the Cuttle Cart:

Set up your Atari 2600 in the same manner you would to play standard cartridges.

Make sure the Atari if OFF. NEVER INSERT OR REMOVE THE CUTTLE CART FROM THE ATARI WHILE THE ATARI IS ON. DOING SO MIGHT RESULT IN DAMAGE TO THE CUTTLE CART AND/OR THE ATARI.

Insert the Cuttle Cart into the Atari 2600's cartridge slot.

Turn on the Atari. The Cuttle Cart title screen should appear. If it does not, turn off the Atari, check your connections, and turn on the Atari again. If the title screen still does not appear, see the trouble-shooting section.

If using a CD player (or cassette player):

Connect the Cuttle Cart's audio plug to the CD player's headphone jack. The Cuttle Cart's connector is a ⅛" mono plug, but

will work in ⅛" stereo jacks such as those found on most portable tape or CD players. A ⅛" to ¼" phono plug adapter will be required for connection to many home audio systems.

Select the CD track containing the game you wish to transfer to the Cuttle Cart, and press the play button on the CD player. Once the transfer has started, the Cuttle Cart display should switch to a colored screen that slowly opens outward while cycling colors. When the game has finished loading it will start automatically. (Note: On large games, there may be an extended period of time at the end of the transfer during which the screen is black. This is normal - just let it continue and the game will start.)

If an error occurs during the transfer, the Cuttle Cart will flash the message "Play Load #00". If this happens, restart the track from the beginning. If the error persists, see the trouble-shooting section.

If the game loads successfully, continue with the "Once the game starts" section.

If using a Computer:

Connect the Cuttle Cart's audio plug into the speaker or line-out jack on your computer's sound card. You will probably have to unplug your computer's speakers to do this. (It is recommended that your speakers not be connected when transferring games, as the audio stream during the transfer is rather grating.)

Various game transfer programs are provided with the Cuttle Cart. Start the game transfer program that is best suited for your computer. Since different computers and operating systems require different programs and procedures, please see the readme.txt file on the disk that came with the Cuttle Cart for instructions on how to operate the programs.

Once the transfer has started, the Cuttle Cart display should switch to a colored screen that slowly opens outward while cycling colors. When the game has finished loading it will start automatically.

(Note: On large games, there may be an extended period of time at the end of the transfer during which the screen is black. This is normal - just let it continue and the game will start.)

If an error occurs during the transfer, the Cuttle Cart will flash the message "Play Load #00". If this happens, restart the transfer from the beginning. If the error persists, see the trouble-shooting section.

Once the game starts:

Once the game starts, the Cuttle Cart will act just like a normal cartridge for that game until the Atari power is turned off. ONCE THE ATARI 2600 POWER IS TURNED OFF, THE GAME WILL BE LOST FROM THE CUTTLE CART'S MEMORY.

If you wish to transfer another game to the Cuttle Cart, turn off the Atari and then turn it back on. The Cuttle Cart title screen will appear and you can now transfer a new game.

If you are using an audio-cassette player to transfer games, you should stop the tape after the transfer is finished. This is especially true for multi-load games, as they will require additional loads to be transferred later in the game, and the next load is typically stored on the same audio tape immediately following the load just transferred. (So that you can just press play on the cassette player to begin the transfer of the next load when requested, without searching through the tape.)

A Note on Multi-load Supercharger Games:

Some of the games designed to work with the original Starpath Supercharger consist of multiple segments (called loads) where, upon reaching a certain point in the game, the Supercharger would request that you transfer the next section by pressing play on the cassette player. (Supercharger games were originally distributed on audio tape.)

In order to play these games, you must initially transfer the

game's first load. If you try to transfer a later load, the Cuttle Cart will flash the "PLAY LOAD #00" message at you because you are trying to transfer something other than the first load. Supercharger loads are numbered starting with 00, so the first load of every game, even single load games, must be 00. Subsequent loads can have any number, as long as it is higher than the preceding load's number.

When you reach a point in a multi-load game where you are requested to transfer the next load, the Cuttle Cart will display the requested load number. Something like "Play Load #01." This allows new games to be developed that request loads in a random order. Unfortunately, the original Supercharger did not display the load number to the user (because finding a random load on an audio tape is impractical.) Since load numbers were invisible to the end-user, no effort was made to ensure that they were consecutive on multi-load games. So when an original Supercharger game asks for the second load to be transferred, the Cuttle Cart may display "Play Load #07", or any other load number. Don't be confused by this, just play each consecutive load in order until you find the one the game is looking for. If the wrong load is played, the Cuttle Cart will flash the "Play Load #XX" message, where XX is the requested load number. If the correct load is played, the Cuttle Cart will display the colored loading screen. You can stop the transfer of an incorrect load at any time and proceed to the next load, or simply let them play until the next load starts (as you would using the original audio tapes.) Playing the wrong load will not affect the game currently being played (as long as all loads are from the same game.)

Trouble-Shooting:

Problem: The Cuttle Cart title screen does not appear when I insert the Cuttle Cart into the Atari 2600 and turn on the Atari.

Suggested Action: Turn off the Atari, and ensure that the Cuttle Cart is fully inserted into the cartridge slot. Turn the Atari back on. If the title screen still does not appear, test that the Atari 2600 is functioning correctly by inserting a standard Atari cartridge

into the Atari. If that cartridge also fails to work, the error is in the Atari and not in the Cuttle Cart. If the Atari is functioning correctly and the Cuttle Cart still fails to display the title screen, contact support@schells.com.

Problem: The Cuttle Cart does not work in my Atari 7800, or does not play certain games correctly in my Atari 7800.

Solution: Many Atari 7800's are not 100% compatible with the Atari 2600. Use of the Cuttle Cart in the Atari 7800 is NOT supported. Please use an actual Atari 2600 instead.

Problem: The Cuttle Cart title screen appears but nothing happens when I try to transfer a game.

Suggested Action: Try increasing or decreasing the volume of the audio source. The Cuttle Cart will only work at certain volume levels. This problem is especially true when connected to a computer having a newer sound card which does not provide an amplified line-out (one that requires powered speakers.) You will most likely have to set the volume near its maximum in order for transfers to work properly. If adjusting the volume does not work, make sure that the audio stream is actually playing by connecting the audio source to a pair of speakers or headphones. MAKE SURE THE VOLUME IS LOW BEFORE TRYING THIS - THE AUDIO STREAMS ARE VERY GRATING AND HARD ON THE EARS. If the audio is present, and there is still no response to transfers contact support@schells.com.

Problem: The game I wish to play using the Cuttle Cart transfers completely, but fails to start or play correctly. (Comes up with a garbled display, etc.)

Likely Causes: If other games work on the Cuttle Cart, but a particular game does not, the most obvious reason is that you have a bad ROM image file or audio file, one that does not contain a valid game. There are two primary factors that lead to improper audio files. The first factor is the bankswitching method specified for the game. The Cuttle Cart emulates several bankswitching

techniques, many of which apply to games of the same size from different manufacturers. If you specify the wrong bankswitching technique when creating the audio file, the game will either not play properly (possibly crashing at some point) or not play at all. The programs supplied with the Cuttle Cart recognize and correctly apply the proper bankswitching technique for most games, but if the game does not work, make certain that you are specifying the proper technique. (You will most likely have to get this information from the game's author or the place where you obtained the game.)

The second factor is whether or not you are transferring "empty pages." Empty pages are 256-byte sections of the ROM image file where all 256 bytes are the same value. The Cuttle Cart programs allow you to not transfer these pages in order to reduce transfer times. However, some games actually require that these pages be transferred. If you are having a problem getting a game to work and the program you are using is set to not transfer empty pages, try setting the program to transfer the empty pages and see if the game works.

Programmer's Section:

This section contains the information on the Cuttle Cart's loading format and operating procedures. It provides a description of the new bankswitching format used by the Cuttle Cart to load larger games, and the original Supercharger bankswitching format, but does not describe other bankswitching formats in detail as that information is readily available in the Atari 2600 programming literature. If you are just using the Cuttle Cart to play games, you do not need to read this section.

The Cuttle Cart audio format is backwards compatible with that of the Starpath Supercharger, but has been extended to work with games larger than 6 kilobytes by utilizing unused bits in the control byte. (The unused bits control the write pulse delay on the original Supercharger, which is not used on the Cuttle Cart.) The extra bits are also used to select the bankswitching format the Cuttle Cart will use after a game has been loaded.

The low level audio information consists of a series of ones and zeros encoded through frequency shift keying, where a zero bit is encoded as a single cycle of a sine wave (NOT COSINE) at a certain frequency, and a one bit is encoded as a single cycle of a sine wave at a different, lower frequency. The starting phase of both sine waves must be the same, and can be either 0 or 180 degrees. The actual implementation passes these cycles through a zero crossing detector, so square waves are acceptable as well, but the 50% duty cycle of each bit should be maintained. Suggested signal amplitudes are between 1 to 5 volts peak to peak.

The transfer is sent as a continuous series of 1 and 0 bits, with each bit immediately following the previous bit. THERE MUST NEVER BE A PAUSE BETWEEN BITS DURING THE ENTIRE TRANSFER!

Suggested Frequency Pairs			
Speed	Typical Transfer Mechanism	One Bit	Zero Bit
Slow	Audio Tape	2.10 kHz	2.94 kHz
Medium	Computer or CD	4.41 kHz	7.35 kHz
Fast	Computer or CD – Under ideal conditions	6.30 kHz	11.025 kHz

Each load should be preceded by a low frequency clearing tone to ensure that the audio detection routines are in a known state. The suggested frequency for this clearing tone is 860 Hz, and the minimum suggested duration is 0.1 seconds.

Directly following the clearing tone, a signal header consisting of alternating 1 and 0 bits should be transmitted, typically for a duration of 1 second. It is during this header that the Cuttle Cart determines the frequencies used to represent 1's and 0's. The end of this header, and the beginning of the actual data is signaled by the presence of two 0 bits in a row.

Directly following the two consecutive zero bits is the game format header, which provides the game's length, control byte, and starting address as well as other information. All information from this point on will be discussed in terms of bytes (8 bits). The bytes are transmitted to the Cuttle Cart one bit at a time starting with the most significant bit and going to the least significant bit.

Data Header Format:

The data header is 8 bytes long and includes a checksum byte which is set such that the sum of all bytes in the header, ignoring overflow, will equal the hex value 0x55.

Data Header Format	
Byte Number	Description
1	Low Byte of Game Start Address
2	High Byte of Game Start Address
3	Control Byte (See Below)
4	Page Count (Number of 256-byte blocks to load)
5	Checksum – Set to make header sum = 0x55
6	Multi-Load Index # (Must be 00 for first load and all single load games)
7	Bar-Counter Low Byte (See Below)
8	Bar-Counter High Byte

The Multi-load index must be 0 for all single load games and for the first load of all multi-load games. Later loads can have any index number, but keep in mind that the Cuttle Cart will display the index number to the game player when requesting a transfer, so sequential numbering is probably a good choice.

The checksum byte is computed as

Checksum = 0x55 - (Sum of remaining 7 header bytes)

The bar-counter bytes are used to set the speed at which the color bars retract during a game transfer. They are completely ornamental. The formulae for proper calculation of the bar-counter bytes are:

Bar-Counter High Byte = (Page Count)/21 + 1
Bar-Counter Low Byte = (Page Count)*256/21 - [(Bar-Counter High Byte)-1]*256

Following the data header, game data is loaded in 256-byte pages. The page-count byte in the data header is the number of pages to load. Note that these pages can be loaded anywhere in memory. (Thus in a multi-load game it is possible to overwrite only certain areas, while leaving others intact, allowing one to preserve data to share across loads.)

Each page of game data starts with the page-bank byte. This byte specifies where in memory the page should be loaded as follows:

Page-Bank Byte = [aaapppbb], where aaapppbb represent bits in the byte going from most significant to least significant from left to right.

The bits [aaabb] represent the address lines A15-A11 on the Cuttle Cart SRAM (can also be thought of as A15-A11 indexing into the ROM being loaded.)

The bits [ppp] represent A10-A8 on the Cuttle Cart SRAM.

To illustrate how the page-bank byte works, here are a few examples:

SRAM Address range page will be written to.	[aaabb]	[ppp]	[aaapppbb]	Page-Bank Byte
0x0000-0x00FF	00000	000	00000000	0x00
0x0100-0x01FF	00000	001	00000100	0x04
0x4000-0x40FF	01000	000	01000000	0x40
0xC600-0xC6FF	11000	110	11011000	0xD8

The next byte for each page is the checksum byte. The checksum byte is calculated such that the sum of all bytes of game data in the page, the checksum byte, and the page-bank byte is equal to the hex value 0x55.

Checksum = 0x55 - (Sum of page of game data) - (Page-Bank Byte)

After these two bytes, the game data itself is sent, starting with the byte with the lowest address in the page and proceeding to the end of the page.

This page sequence is repeated for all remaining pages until all data has been sent.

After all data has been sent, it is recommended that a trailing footer of alternating 1 and 0 bits is played for a brief period, just to provide a clean ending to the transfer and avoid any glitches or cutoff in the audio device. The duration of the footer is unimportant as the transfer is actually complete after transmission of the final byte of the final page of game data. (The original Supercharger would display the message "Stop Tape" during this footer to remind the user to stop the audio-cassette player. The Cuttle Cart, designed for random access media such as CD players and computers, ignores the footer entirely.)

Control Byte:

The control byte tells the Cuttle Cart which mode to switch to after a game has loaded. Basically it selects the bankswitching scheme of the game loaded. The acceptable values are shown in the table on the following page.

Control Bytes		
Bankswitching Mode	Bankswitching Description	Control Byte (Hex Bytes)
Cuttle Cart	64K Cuttle Cart Mode	[10wbbbbb] (See Below)
Starpath Supercharger	6K Starpath Supercharger Mode	[000bbbwr] (See Below)
2K	Standard 2K Cart (No Bankswitching)	0xCA
CV	Commavid 2K with 1K RAM	0xEA
4K	Standard 4K Cart (No Bankswitching)	0xC8
F8	8K Atari Standard	0xC6
F8SC	8K Atari Standard with Superchip	0xE6
F6	16K Atari Standard	0xC4
F6SC	16K Atari Standard with Superchip	0xE4
F4	32K Atari Standard	0xC2
F4SC	32K Atari Standard with Superchip	0xE2
FA	CBS 12K with RAM+	0xE0
FANR	CBS 12K without RAM	0xC0
E0	Parker Brothers 8K	0xC1
E7	M-Network with extra RAM	0xE3
E7NR	M-Network without RAM	0xC3
MB	Megaboy 64K	0xC9
FE	Activision 8K	0xCC
3F	Tigervision 8K up to 64K	0xCE (See Below)

Most bankswitching schemes are already described in the Atari 2600 developer's literature, and their description will not be repeated here. Only the Supercharger and Cuttle Cart modes will be described here, as well as a minor modification that has been made to Tigervision 3F mode to expand it to work with games up to 64K in size.

Tigervision 3F Bankswitching Changes:

Tigervision 3F bankswitching was only actually implemented for 8K carts, but is extended in the Cuttle Cart to allow access to up to 64K. To maintain compatibility with existing Tigervision games, the upper 2K of Atari cart space will always point to the 4th 2K page of the SRAM ([A15-A11] = [00011], or address ranges 0x1800-0x1FFF). For the lower 2K, A15-A11 are controlled by writing the desired value to Atari 2600 address 0x3F. The 5 least significant bits of the byte written to 0x3F will be latched into A15-A11. To illustrate, if your program wrote 0x12 to Atari address 0x3F, then on subsequent accesses to the lower 2K of cart space the A15-A11 lines of the SRAM would be set to [10010] and memory locations 0x9000-0x97FF of the SRAM would be accessed.

Access to the Control Byte after a program is loaded:

If the bankswitching mode specified in the control byte of a transfer sets either Cuttle Cart or Supercharger mode, the loaded program will be able to change the control byte programmatically (details below.) Once a bankswitching scheme other than Cuttle Cart or Supercharger mode is selected, the Cuttle Cart will be locked in that mode and all features of Cuttle Cart and Supercharger mode will be lost until power is cycled on the Atari. (Because the Cuttle Cart is now emulating a mode that does not use the control byte.)

Original Supercharger Mode Changes:

Supercharger mode on the Cuttle Cart is activated by setting the two most significant bits of the control byte to zeros. These bits (as well as the third most significant bit) are normally used by the Supercharger to hold the write pulse delay, which is not used in the Cuttle Cart. Since the write pulse delay in the original Supercharger was determined by the BIOS at startup, these bytes are not altered by Supercharger games. However, if you wish to develop a Supercharger compatible game on the Cuttle Cart, you MUST keep the three most significant bits of the control byte intact. (The control byte, with corresponding write pulse delay, is stored at Atari RAM address 0x80 after a successful transfer. Multi-load Supercharger programs must also ensure that the write pulse delay bits are intact at address 0x80 before requesting the transfer of a new segment.) The Supercharger relies on these bits being set to a specific value determined at run time in the Supercharger BIOS. If you just clear these bits to zero, your game will work on the Cuttle Cart, but will most likely crash on the Supercharger. The remaining 5 bits of the control byte in Supercharger mode are used to set the bank configuration, control whether or not RAM writing is enabled, and determine the power up state of the ROM. Specifically, representing the control byte as [000bbbwr], bbb determines what is mapped into the upper and lower 2K banks according to a look up table (see below), w determines whether or not RAM writing is enabled (1 = enabled), and r determines whether or not the ROM chip on the Supercharger is

powered (1 = powered.) The r bit has no effect on the Cuttle Cart. (On the Supercharger you must delay after powering up the ROM before attempting to access it. This is not true on the Cuttle Cart, so it is another area to watch for incompatibilities.)

Supercharger mode allows access to 6 kilobytes of SRAM, the same as contained on the original Supercharger. The SRAM is broken into three 2-kilobyte banks, numbered 1 through 3. Bank 1 maps to SRAM addresses 0x0000-0x07FF, bank 2 to 0x0800-0x0FFF, and bank 3 to 0x1000-0x17FF. The Cuttle Cart BIOS ROM (or Supercharger BIOS ROM on the original Supercharger) is also accessible, but only in the upper 2K of Atari cartridge space. The BIOS ROM should only be used for handling the transfer of loads in multi-load games, as described later in this manual. What is mapped into the upper and lower 2K of Atari cart space is determined by the [bbb] segment of the control byte as shown in the following table.

Supercharger Bank Selection		
Control byte [bbb]	Atari Addresses 0xF000-0xF7FF	Atari Addresses 0xF800-0xFFFF
000	RAM Bank 3	BIOS ROM
001	RAM Bank 1	BIOS ROM
010	RAM Bank 3	RAM Bank 1
011	RAM Bank 1	RAM Bank 3
100	RAM Bank 3	BIOS ROM
101	RAM Bank 2	BIOS ROM
110	RAM Bank 3	RAM Bank 2
111	RAM Bank 2	RAM Bank 3

There is one final difference between the original Supercharger and the Cuttle Cart in Supercharger mode for multi-load games. The original Supercharger always over-writes the information stored in the last 256-byte page of SRAM bank 1 when a transfer of a new load is requested. This happens regardless of whether or not the new load actually writes data to this page. The Cuttle Cart does NOT automatically over-write this page, so be certain not to use it to store data that is shared between loads, or your game will work on the Cuttle Cart and not on the Supercharger.

The details on accessing the control byte, writing to RAM, and

requesting new loads in Supercharger mode are covered in the Cuttle Cart mode description below.

Cuttle Cart Mode:

Cuttle Cart mode is used for loading all games, including Supercharger games, into the Cuttle Cart. It is predominately designed for just that purpose, and is not very flexible. However, it's description also contains all the additional details you need to know to write Supercharger mode games. Cuttle Cart mode is selected by setting the two most significant bits of the control byte to [10]. The entire control byte is defined as [10wbbbbb], where w determines whether or not RAM writes are enabled (w = 1 allows writes), and bbbbb sets the address lines A15-A11 on the SRAM for the lower 2K window of Atari cart space. The upper 2K of Atari cart space is always mapped to the Cuttle Cart BIOS ROM. It cannot be swapped out.

Writing to RAM and setting the control byte are fairly complicated. Everything is determined in terms of address changes. Each change of the Atari address bus values represents one cycle to the Cuttle Cart. Values to be latched into the control byte or written to RAM are set by accesses to Atari address locations 0xF0yy, where yy is the value that is latched. This data is held in a data hold register until replaced by another access to 0xF0yy. An access is defined as any action that sets the Atari address bus to the specified values (i.e. 0xF0yy for the data hold register, or 0xFFF8 for the control byte latch). This means, for example, that if your code runs from locations 0xF000-0xF0FF it will be constantly altering the value of the data hold register whether you intended it to or not! The procedure is timing based too, so here are the details:

(The following rules for RAM writes and control byte access also apply to original Supercharger mode, except that in Supercharger mode a RAM write will occur if the address of the 5th cycle points to an Atari cartridge location that currently has a RAM bank mapped into it, rather than just to the lower 2K of cartridge space.)

If RAM Writing is disabled (w=0):

Any access to Address 0xF0yy will latch the value yy into the data hold register. An access to Address 0xFFF8 will write the value in the data hold register into the control byte register. (Allowing one to change where the lower 2K points, the bankswitching mode, or the write enable status.)

If RAM Writing is enabled (w=1):

If no RAM write is pending, an access to address 0xF0yy will latch the value yy into the data hold register, and start a RAM write pending.

If a RAM write is pending, then accesses to 0xF0yy will NOT latch data into the data hold register.

A RAM write occurs on the 5th Cuttle Cart cycle after the access that started the write pending (not counting the access that started the write pending.) Note, Cuttle Cart cycles are NOT 6507 machine cycles, they are counts of changes in the address bus. The Atari 2600 Cart port does not allow access to the 6507 clock lines which would be required to count machine cycles. If the address of the 5th cycle points to a location in the lower 2K of Atari 2600 cartridge space (0xF000-0xF7FF), the data latched into the data hold register will be written to the RAM location whose address consists of A15-A11 as held in the control byte register, and A10-A0 from the address of the current instruction.

Examples of typical writes (after writes have been enabled) follow. The examples show typical code that can be used to accomplish RAM writes, along with the sequence that will occur on the Atari address bus when the code is executed to illustrate how Cuttle Cart cycles are counted. Note that any cycle count listed as 0 indicates that no write is currently pending. Also note that $xxxx notation for hex values has been adopted for these examples to match typical assembler instruction format.

Example 1:
  Assuming:
    Control byte contains $B9 [10111001]
    $E0 contains $CD, $E1 contains $F6 (to form address
      $F6CD)
    X contains $55
    Y contains $01
    No write is pending at the start of this example

Program Counter:	Code at PC:	Address Bus Value/Count
$F123	LDA $F000,X	$F123/0, $F124/0, F125/0, $F055/0

    Access to $F055 latches 0x55 into data hold register and
    starts write pending.

$F126	LDA ($E0),Y	$F126/1, $F127/2,
		$00E0/3, $00E1/4, $F6CE/5

    Since the address $F6CE occurs on the 5th access cycle
    after the start of write pending, and $F6CE is in the lower
    2K of Atari 2600 cartridge space, the value 0x55 will be
    written to the SRAM address $CECE determined by

Control Byte:	Address Bus at 5th Cycle:	SRAM Write Address:
101[11001]	11110[11011001110]	[11001][11011001110] = $CECE

Example 2: Performs the same write as Example 1.
  Assuming:
        Control byte contains $B9 [10111001]
        No write is pending at the start of this example

Program Counter:	Code at PC:	Address Bus Value/Count
$F123	LDA $F055	$F123/0, $F124/0, F125/0, $F055/0

    Access to $F055 latches 0x55 into data hold register and
    starts write pending.

$F126	NOP	$F126/1
$F127	LDA $F6CE	$F127/2, $F128/3,$F129/4, $F6CE/5

The 5th Cycle ends at the same address, so the same write as in Example 1 is accomplished.

Note that Cuttle Cart/Supercharger mode RAM writes are done using read instructions. This is critical. DO NOT ATTEMPT A CUTTLE CART OR SUPERCHARGER RAM WRITE USING A WRITE instruction. This will create a bus contention, as both the 6507 and the Cuttle Cart/Supercharger would be driving the bus at the same time. (The Cuttle Cart/Supercharger must put the data on the bus in order to write it into RAM.)

If the address at the 5th cycle does not point to a location in the lower 2K of Atari cart space, no write is performed, and the write pending is cancelled.

If at ANY TIME the address 0xFFF8 is accessed, the data in the data hold register will be latched into the control byte register, and any write pending will be cancelled. There is no 5 cycle timing structure for writes to the control byte, they can happen at anytime.

Other features of Cuttle Cart Mode:

Another feature of Cuttle Cart mode is the ability to sample the state of the audio-input line by reading from address 0xFFF9. The read will return the value of the audio line in the least significant bit, with the rest of the bits set to zero. (In Supercharger mode, the audio line is only available if the BIOS ROM is mapped into the upper 2K of Atari cartridge space.)

If you wish to create a multi-load game, the procedure for requesting the next load is as follows:

Write the requested load number into Atari address 0xFA.
Execute the command JMP $F800.

The Cuttle Cart BIOS will take over, and handle the transfer of the requested load. Upon completion of the transfer, the Cuttle Cart will jump to the address specified as the start address in the head-

er of the load just transferred. The control byte will also be set according to the load just transferred, and will be stored in location 0x80. The Atari 2600 RAM and registers will be altered as follows. (Note: these same changes occur after the first load transfers as well.)

TIA registers from 0x04-0x2C are set to zero.
RAM from 0x81-0x9D is set to 0.
RAM location 0x80 contains the control byte.
RAM location 0xFF contains high byte of load start address.
RAM location 0xFE contains low byte of load start address.
RAM locations 0xFA-0xFD contain, respectively,
    [0xCD,0xF8,0xFF,0x4C].
Stack Pointer = 0xFF.
X contains 0xFF.
Y contains 0.
A contains a random number (usable as a random number
    seed).

Multi-loads in Supercharger mode and handled the same way, but again, remember that the write pulse delay bits must be stored in the three most significant bits of Atari RAM location 0x80 before you execute the JMP 0xF800 instruction. Also, the BIOS ROM must be mapped to the upper 2K of cartridge space (and on the original Supercharger must have been allowed to power up.)