

Atari 7800 Development System / Cart Dumper

Introduction

This document describes how to modify an Atari 7800 to be a cart dumper for Atari 2600 and 7800 games, and how to build a RAM cart for the 7800 that allows many 2600 and 7800 games to be uploaded to a 7800 and played. The theory is to install a custom BIOS that runs when you turn on the 7800 console which uses a joystick port to communicate with a PC. Once you've modified the 7800 for the new BIOS EPROM and install the new BIOS, all you need to do is build a cable to have a cart dumper. The RAM cart requires that an old Atari 7800 cart be modified to take a RAM instead of the game PROM.

Warning – No Warranty!

Warning, we are not responsible for the accuracy of this document or the correct functioning of any of the software. And even if the information and software is perfectly correct, accidents can happen. So if your 7800 goes up in smoke, or you lose all of the data on your PC, or your 1GHz Athlon motherboard gets toasted trying this stuff out that's **your** problem. Not ours.

Modifying the 7800 for an EPROM

As it turns out, some 7800's were shipped from the factory with EPROM's already installed. These 7800's don't need to be modified. If your 7800 is model number C300633 or C070856, and it was made around 1989, you *may* be able install an EPROM directly. Otherwise you should follow the directions published by Bruce Tomlin in May of 1996. Just use the 7800 DevOS BIOS (currently devos01.bin) to program the EPROM with. You don't need to worry about whether your 7800 is NTSC or PAL either. DevOS works fine in either kind of machine.

Here are Bruce's 7800 EPROM conversion instructions:

Subject: 7800 EPROM conversion
From: btomlin@crl.com (Bruce Tomlin)
Date: 18 May 1996 14:07:11 -0700

Parts needed:

74LS04 chip (No other 74x04 variants! I tried a 74F04 and it didn't work.)
28 pin IC socket
EPROM chip, either 2732, 2764, or 27128
About 5 inches of wire wrapping wire, and a razor blade to help strip it
Soldering iron, solder, desoldering iron, etc.

- 1) Desolder the old ROM chip. This is the one marked "CO24922". If you haven't desoldered chips before, get some practice or buy a pizza and split it with a friend who has. (See end of this file for tips on how to desolder an IC chip.) Also suck the solder out of the four extra holes.
- 2) Strip one end of the wire wrap wire and put it into the pin 22 hole. This is the one to the "right" of the letters "DBM".
- 3) Insert the 28 pin socket into the holes and solder it down, along with the wire wrap wire. Test your work by putting the ROM chip back in and plugging in a 7800 game. If the "ATARI" screen comes up and then the game starts, everything is okay.

- 4) If you are going to be using a 28 pin EPROM chip, suck the solder out of the holes marked "W1" and desolder the resistor-like thing from the adjacent holes (which are marked "W2"). It may look like a resistor, but if it is, it's zero ohms. Solder the resistor-thing into the W1 holes.
- 5) Take the 74LS04 chip and bend up all but the four "corner" pins (1, 7, 8, and 14). Piggyback it over the 74AHCT08 or 74LS08 chip which is just above the biggest chip on the board. Solder down pins 1, 7, and Now bend up pin 8.
- 6) Strip off the other end of the wire wrap wire and wrap the end around pin 2 of the 74LS04. Before putting it on the 74LS04, thread it under some resistors and capacitors to keep things tidy. Solder the wire to the pin.
- 7) Find the trace on the bottom of the circuit board that goes between pin 1 of the 7408 and the ROM pin that you stuck the wire wrap wire into. There is a place next to the 7408 where you will have enough room to cut the trace safely. Cut it.
- 8) Program a 2732, 2764, or 27128 EPROM (or a 28xxx EEPROM if you prefer) with a copy of the 7800 ROM in the last 4K.
- 9) Put the ROM into the socket and test everything by plugging in a 7800 game. Now you're done!

Hints for desoldering:

- ★ I use a Radio Shack desoldering iron. This has a red rubber bulb on it and a hollow tip. It's cheap and works well.
- ★ Use a fresh tip for important projects! It's not worth trying to save two bucks only to ruin a circuit board or a chip. Tinning your tip is a good idea, too.
- ★ Wait for the joint to completely melt before sucking out the solder. If you suck too soon, you may not be able to melt the joint properly any more. Wait about four seconds, or five for the four "corner" pins.
- ★ When you have sucked out the solder from all of the holes, push all the pins to "crack" them off of the remaining solder.
- ★ If you have done everything right, the chip should practically fall out of the board.

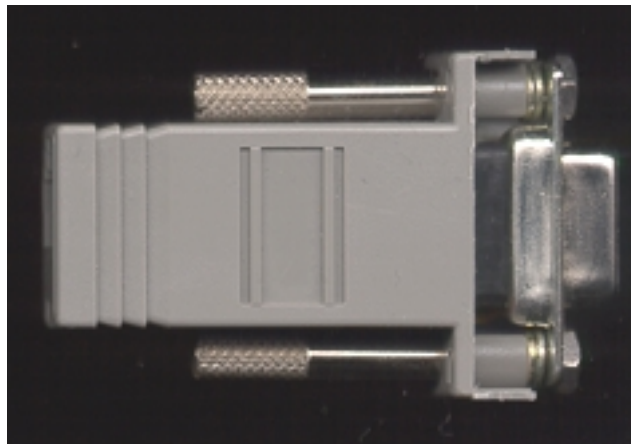
If you don't have a special desoldering iron, another method for removing a chip may be used. First cut the chip out with some sharp flush cutters, cutting right next to the body of the chip leaving the legs soldered into the board. Some soldering irons are magnetic and the leg will stick to the soldering tip automatically so that it is easily lifted from the board if you melt the solder from the top of the board. Otherwise, you can turn the board upside down and melt the solder from the bottom. Then shake or tap the board so the leg falls out. Be careful doing this. After removing all of the legs, any remaining solder is easily removed from the holes with a regular solder-sucker. Note that if you use this method for removing the chip, you won't be able to do the test in Bruce's step 3.

Building the Cable

Two methods of building a cable have been tried. Both were a little tricky because a normal DB-9 connector won't plug into the 7800 without modification. This is because the 7800 case hangs over the joystick ports very closely. When a regular solder pot connector was used, a belt sander was used to remove some of the metal so that it would plug into the 7800 smoothly. It was not possible to attach the hood, so the wires were left exposed in this case. A modular connector was also tried. In this case it was

possible to attach the hood, but some of the plastic needed to be removed so that it would plug in properly. A "ginsu" steak knife was useful for this.

Here are some pictures of the modular connector showing the removed plastic and the construction technique:

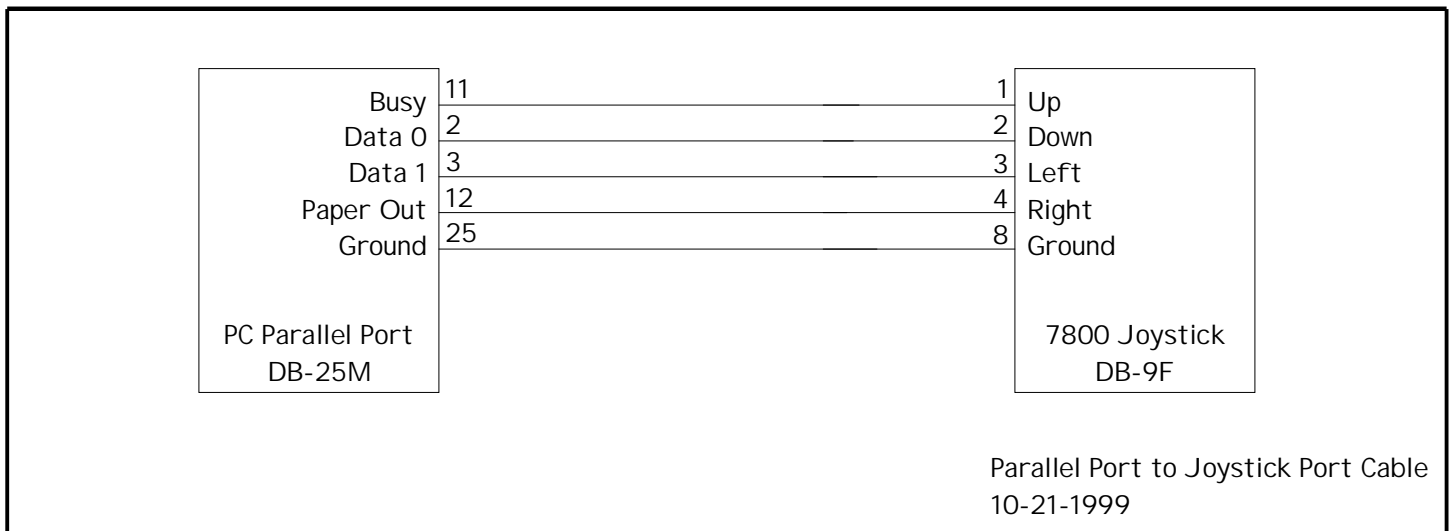


Note the two washers used as spacers to prevent the screws from projecting too far which would prevent the cable from plugging in.

Maybe the best way to build the cable is to use the cable from an old joystick. Remove the joystick from the cable and attach a DB-25 connector to this end of the cable to plug into the PC parallel port. But this method was not tried, and we don't know if a standard joystick cable has all of the required connections.

The joystick end of the cable is then plugged into the right joystick port of the 7800. The PC end of the cable is plugged into a parallel port on your PC.

Here is a schematic of the cable:



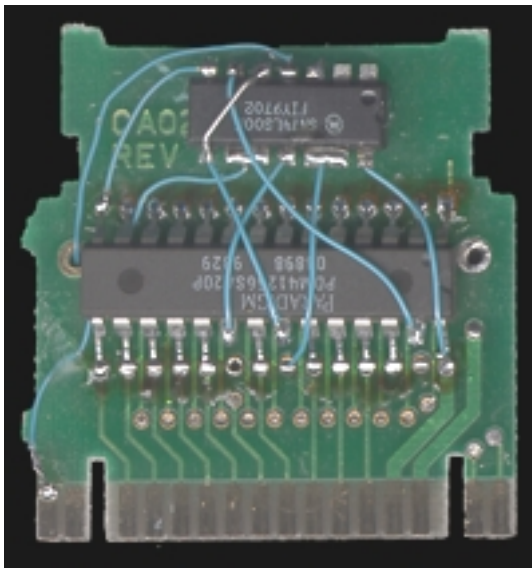
Building the RAM Cart

An old 7800 Joust cart as well as an old 7800 Dig Dug cart have been successfully modified to be RAM carts. It may be possible to use other 16KB or 32KB games as a starting point as well. Additional parts you will need are a 74LS00, and a 32KBx8 SRAM. Standard TTL 7400 chips have been used as well as 74LS00 chips but the 74LS00 is probably a better choice. For the SRAM, two kinds of cache chips left over from some old PC motherboards have been used. The part numbers that worked are Paradigm PDM41256SA20P, and EtronTech EM51256C-15P. Regular "garden variety" KM62256LP-12 chips were also tried but they proved to be unreliable. Perhaps the 120ns access time was too slow. Or maybe it was because the SRAM was in a socket at the time. In any case, be sure the pinout of your SRAM matches the pinout shown in the schematic below.

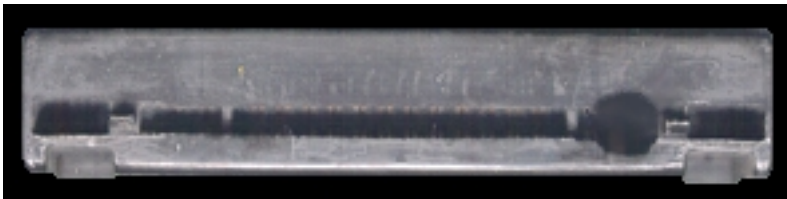
- 1) Take the cart apart, remove the game PROM from the circuit board, and suck the solder out of the holes.
- 2) If you're using narrow cache RAM's, bend the legs into a "gull-wing" configuration. That is, bend the pins almost but not quite horizontal so that the ends of the pins just barely go into the holes.
- 3) Bend pins 20, 22, and 27 of your SRAM completely horizontal and cut off the end of the pins leaving only the "flaps" to solder onto.
- 4) Solder the SRAM into the circuit board except for pins 20, 22, and 27 that you bent up previously. If you're using the narrow cache RAM's, solder from the top of the board, otherwise solder from the bottom of the board in the normal fashion.
- 5) Jumper hole 27 of the circuit board to pin 1 of the SRAM running the wire on the bottom of the board (A14).
- 6) Bend the pins of a 74LS00 horizontal and cut off the ends leaving only "mini-flaps." This means the "flaps" should be about half their normal size when you're done.
- 7) Attach the 74LS00 to the circuit board with hot glue. If your circuit board has a 0.1uF capacitor on the top you might want to remove it and put the 74LS00 there. Otherwise that space next to the SRAM will be free and you can go ahead and just mount the 74LS00.
- 8) Jumper pin 14 of the SRAM to pin 7 of the 74LS00 (GND).
- 9) Jumper pin 28 of the SRAM to pin 14 of the 74LS00 (+5V).

- 10) Jumper hole 22 of the SRAM to pins 12 and 13 of the 74LS00 (old OE-).
- 11) Jumper pin 11 of the 74LS00 to the lifted pin 20 of the SRAM (CS-).
- 12) Jumper finger 1 of the circuit board to pins 9 and 10 of the 74LS00 (RW-). Be careful here to only use a small amount of solder on the end of the finger closest to the chips on the circuit board. Otherwise you might not be able to plug the board back into the 7800. Also keep the wire as close as possible to the circuit board and hot-glue it down so it doesn't catch on something and break off.
- 13) Jumper pin 8 of the 74LS00 to pin 22 of the SRAM (OE-).
- 14) Also jumper pin 8 of the 74LS00 to pin 5 of the 74LS00.
- 15) Jumper finger 32 of the circuit board to pin 4 of the 74LS00 (CLK2). Use the same precautions that you used when you were soldering onto finger 1 of the circuit board.
- 16) Jumper pin 6 of the 74LS00 to pin 27 of the SRAM (WE-).
- 17) You may want to attach a 0.1uf capacitor at some convenient place. If your board used to have one next to the PROM you can attach one using the original holes on the bottom of the board. Otherwise maybe attach it between pin 28 of the SRAM and the ground plane on the bottom of the board.
- 18) After you have tested your RAM cart using the software described below, you will probably want to put the circuit board back into the cart case. If your case has a moveable slot, you will want to carve out a portion of the slot to allow additional clearance for the wires that you have attached to the fingers of the circuit board. Likewise, you will want to carve out a portion of the slot on the 7800's cartridge receptacle. You don't want to break those wires.

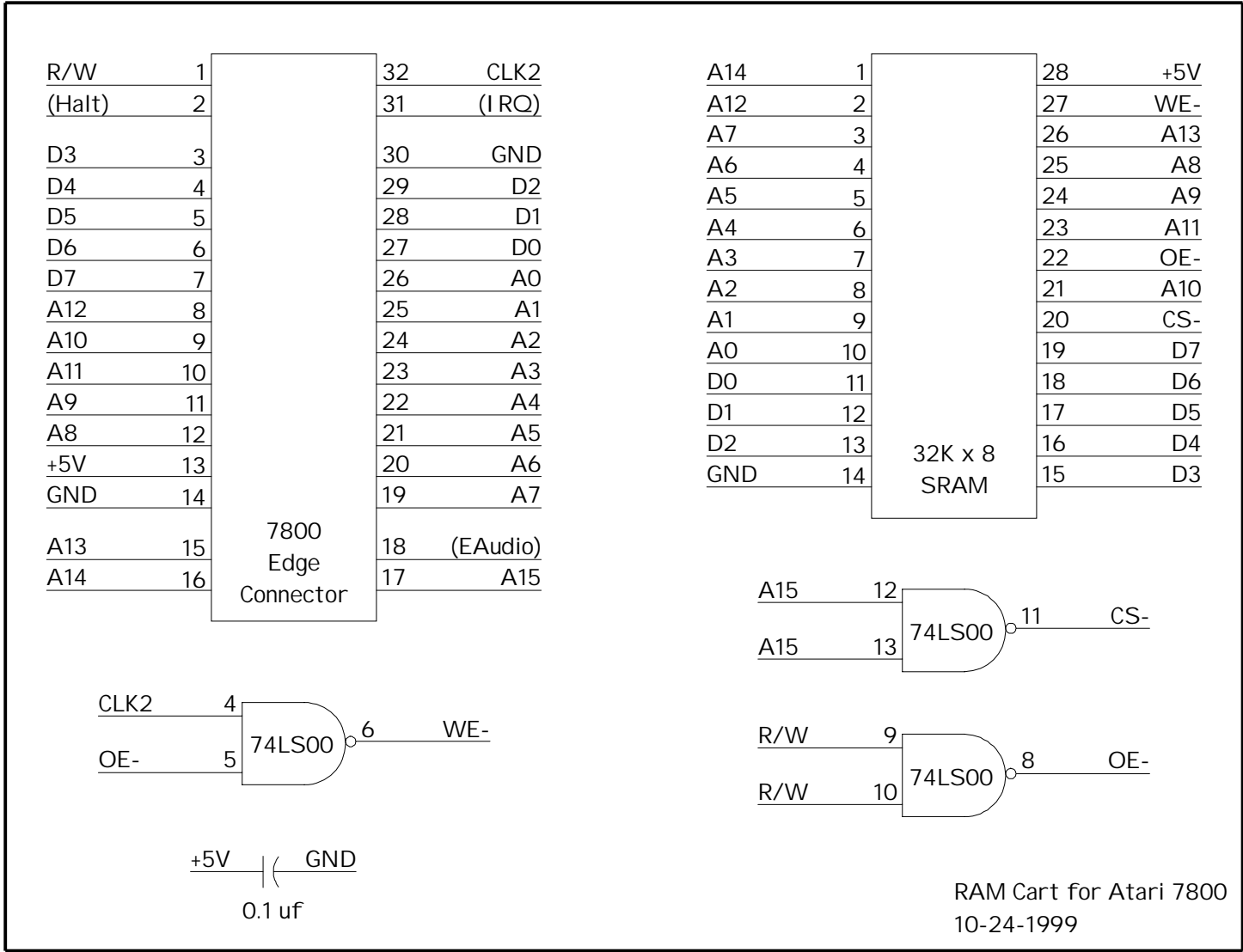
Here are some pictures of a completed RAM cart circuit board:



Here is a picture showing the carved enlargement of the slot on the 7800 cart receptacle. The slot is enlarged on the side where finger 1 and finger 32 of the RAM cart plug in. A Swiss Army knife was used here.



Here's a schematic of the resulting RAM cart:



Running the DevOS BIOS

After installing the DevOS bios, you should see a menu similar to the following when you turn on the machine:



You move the arrow at the left side of the screen to choose your selection by pressing the "Select" button on the 7800. When the arrow is positioned at your desired selection you then press the "Reset" button to activate it. With the DevOS BIOS, you don't need a RAM cart to play games, you can still play regular carts by selecting the correct game type.

Running the PC Software

The software that runs on the PC (currently 7800ctrl.exe) is MS-DOS compatible but it seems to run in a DOS box under Windows 95/98 just fine. The main important point is to make sure that you start the transfer on the 7800 before starting the software on the PC.

Transferring from PC to the 7800

First start the transfer on the 7800 then type a command to the DOS prompt similar to the following:

```
7800ctrl -tSEND filename.bin
```

This will send the file named **filename.bin** over to the 7800. When the transfer is complete, the PC will return to the DOS prompt, and the 7800 will return to the menu. If you want to play the game you just uploaded to the 7800 make the appropriate selection and press "RESET" on the 7800 to start the game.

Transferring from the 7800 to the PC (Cart Dumping)

First start up the transfer on the 7800. Then type:

```
7800ctrl -tTEST filename.bin
```

This automatically tests the cart type and downloads it to your PC into a file called **filename.bin**. If for some reason the software detects the wrong cart type, you may specify a different parameter to the **-t** command line switch as follows to force a particular cart type to be dumped.

```
7816  7800 16K game
7832  7800 32K game
7848  7800 48K game
78SG  7800 Super Game game
```

```
262K  2600 2K game
264K  2600 4K game
```

26F8	2600 F8 bankswitch game
26E0	2600 E0 bankswitch game
26P2	2600 Pitfall II
26FA	2600 FA bankswitch game
26F6	2600 F6 bankswitch game
26E7	2600 E7 bankswitch game
26F4	2600 F4 bankswitch game
26F0	2600 F0 bankswitch game

Choosing the Printer Port

You may specify a printer port number to use (1-3) with the **-I** command line parameter.

Other Options

A complete list of options for the PC program may be obtained by typing a command similar to the following:

```
7800ctrl
```

There currently aren't any other options, but in case any are added or you forget what they are.

Acknowledgements

Thanks to Lee Krueger for supplying us with a number of 7800's which were very useful for testing. He also loaned us some rare carts for testing the cart dumper software.

Thanks to Dan Boris for publishing the 7800 programming information on his webpage and for explaining some things about the 7800.

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Thanks!

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