Dr. Dobb's Journal

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January 1985
Volume 10, Issue 1

CONTENTS

Newcomers

We are fortunate to have found a part time technical editor in Alex Ragen, a senior systems analyst and project leader at Tandem Computers, Inc. Alex's extensive programming experience and writing ability help us to ensure the accuracy and readability of the editorial content of *DDJ*. Another newcomer is Frank DeRose, assistant editor. Frank is an experienced writer and teacher. He was using the Unix system at U.C. Berkeley to compose his dissertation before we lured him away from academia to assist the Doctor.

This Month's Cover

William Cone, this month's cover artist, used a Macintosh drawing with underpainting in gouache and acrylic to depict this hungry Mac.

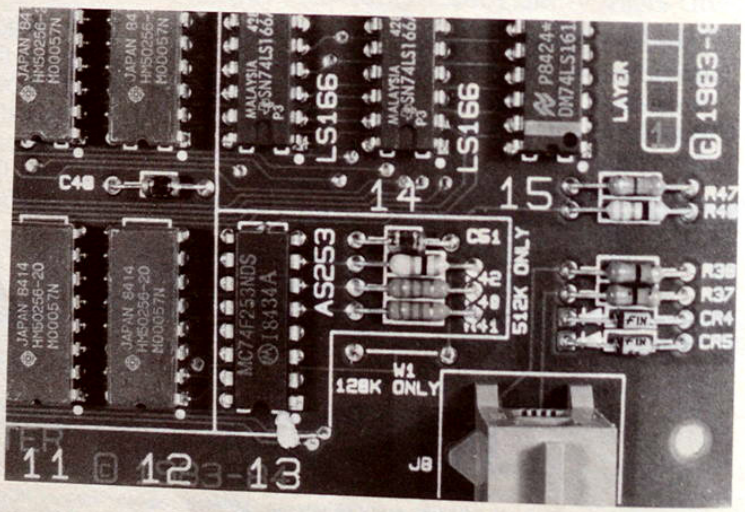
This Month's Referees

Robert Blum, Contributing Editor
David Cortesi, Resident Intern
Thom Hogan, Editor-in-Chief, Business Software

Mac Addendum

This arrived too late to make it into the "Fat Mac" article. If you have the newer 128K motherboard, when you get to page 20 you will need to follow these instructions to install the memory select logic.

1) Cut and remove jumper W1 (marked 128K only) located at G14 (see photo on this page)
2) Install and solder two 2.2K ¼ w resistors at locations R40 and R41
3) Install and solder a 47 ohm ¼ w resistor at location R42
4) Install and solder a .luf capacitor at location C51
5) Install a 74AS253N IC into the socket at location G13
6) Check the motherboard for any solder splashes, or broken etch. Clean the board with alcohol or a TG degreaser to remove any flux left after soldering



SOFTWARE TOOLS FOR ADVANCED PROGRAMMERS

Dr. Dobb's Journal

ARTICLES

COLUMNS

DEPARTMENTS

Fatten Your Mac

by Tom Lafleur and Susan Raab

Veteran microcomputer hardware hackers have denounced Apple for abandoning the principle of an open architecture with the Mac. But to the true hacker, all architectures are open.

The modifications described in the article by Lafleur and Raab are not for amateurs. In fact, we can't with a clear conscience recommend that you void your warranty and risk destroying your motherboard to save a few dollars. Although we've taken steps to convince ourselves of the technical accuracy of the article (and we know that Tom Lafleur has used this procedure on several Macs), we haven't yet had the nerve to fatten a Mac ourselves. Don't take this on as a first hardware project. Don't undertake it if you aren't sure of the risks involved. And don't blame us if anything goes wrong. We are providing this information strictly as a service to those who know how to use it. We take no responsibility for fried Macs. If you have the newer 128 motherboard, read the addendum on page 4.

Are you tired of those pesky disk writes while using MacPaint? Does the performance of even your new hard disk drive leave you longing for the lightning response of a RAM disk? Want to run Lotus 1-2-3 and can't, or are you developing MAC software and just plain running out of room?

For these and many other reasons, Macintosh owners everywhere are rushing to Apple for a FAT MAC upgrade that packs a full 512K of memory into the system. Most will (and should) wait for Apple to add the necessary chips to the Macintosh motherboard. However, if you are one of the adventurous few willing to sacrifice your Apple warranty and wager the life of your Macintosh against your soldering skills, here's how to perform the upgrade yourself for half the cost.

You'll Need. . .

The checklist in Table I (page 21) shows the parts and tools you'll need to complete the job. To minimize your MAC's down time, make sure you have everything on the list before you begin. All of the parts can be found at your local electronics supply house or by looking for ads in your favorite computer magazine.

Because the 256K RAM chips are a little harder to find, I have listed a few sources. We have paid $15 to $45 each for the memory chips: they are not cheap! We've tested only NEC memory chips in this conversion, but other equivalent 256K memory chips should work as well. Once you've got the parts and equipment together, you're ready to begin.

The Procedure

You'll need about four hours of quiet concentration to complete this upgrade yourself. Before you begin, read through the entire procedure. Then disconnect all cables from the Macintosh, including the keyboard, mouse, printer, extra drive, power, and anything else you might have plugged in.

(1) ~~Remove~~ **the case screws.** Use the Xcelite XTD-10 Torx screwdriver to ~~remove~~ all five of the case screws (see Photo 1 on page 20). There are two near the bottom, one inside the battery case, and two deep inside the handle.

Do not remove any of the screws! Simply loosen them in the well.

Tom Lafleur, P.O. Box 490, Del Mar, CA 92014.

Susan Raab, Digital Research International, 160 Central Avenue, Pacific Grove, CA 93950.

(2) **Remove the case.** Turn the Macintosh facedown on a table. Gently press down on the battery compartment, power connector, and I/O connectors while you lift up on the back of the case. The back of the case should come off in your hands, leaving the faceplate in position around the screen and disk drive door. If the case is stubborn, ~~insert a long metal ruler into the the seam between the faceplate and the back of the case (see Photo 2, page 20). (*Do not* use a screwdriver here.) Use the ruler to gently pry the seam open as you pull up on the back of the case.~~ See note at bottom

(3) **Remove the motherboard.** Find and disconnect the two cables that attach the display board and disk drive to the motherboard (see Photo 3, page 20). Ease the motherboard from its connections and remove it from the chassis. Check the revision number of the motherboard. We've successfully performed this upgrade on motherboards that have the revision numbers 630-0101 screened on top and 820-0086C etched on the back.

(4) **Locate and remove the memory chips.** You'll find sixteen memory chips with part number MT–4264 at IC locations F5 through F12 and G5 through G12 (see Photo 4, page 20) Remove them from the motherboard as follows:

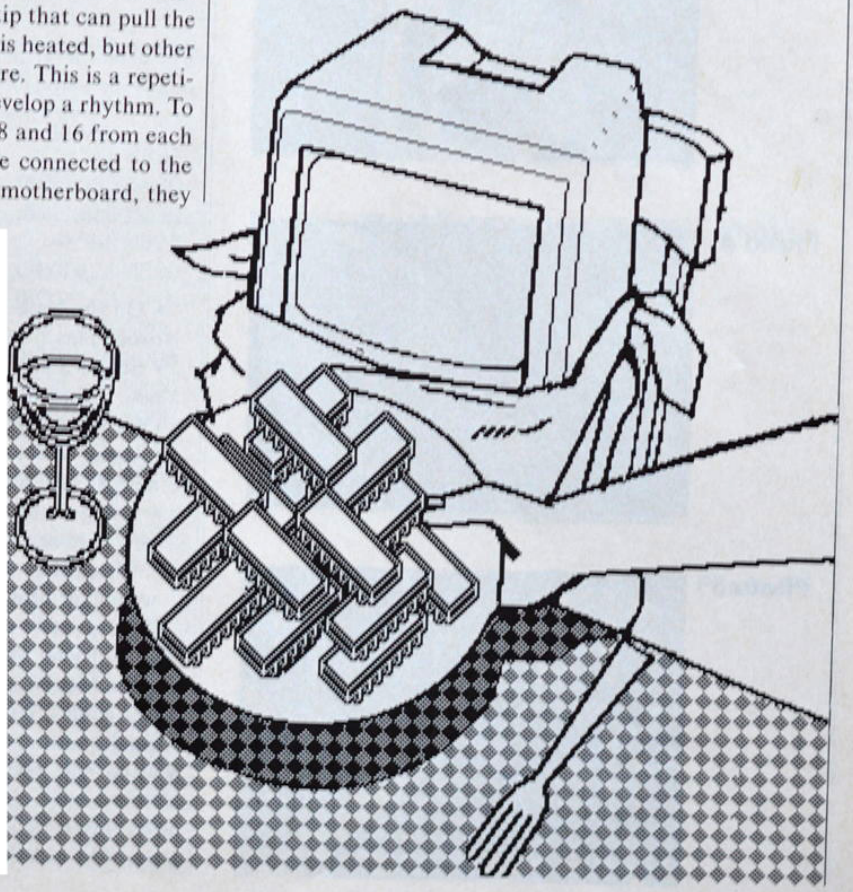
- Using a small pair of wire cutters, clip all the pins off each chip as close to the chip as you can (see Photo 5, page 20). Then throw away all 128K of these memory chips—they aren't as valuable as the Macintosh motherboard!
- Using a low-temperature soldering iron (700°), remove all the memory chip pins from the motherboard (see Photo 6, page 21). It's handy to use a Weller WTCPN soldering station because it has a magnetic tip that can pull the pin out of the board as soon as the pin is heated, but other soldering irons will work if you use care. This is a repetitive task (256 pins!) and you'll soon develop a rhythm. To keep the rhythm going, skip over pins 8 and 16 from each chip on the first pass. Because they're connected to the inner power and ground layers of the motherboard, they require more heat and time to remove. If you remove them on a second pass, they'll establish their own rhythm.
- Clean out all the holes with a solder sucker (see Photo 7, page 21). Again skip holes 8 and 16 on your first pass to keep your rhythm going, then clean them out on a second pass.
- Clean the motherboard with a fine brush. Look the board over for any solder splashes or broken etch.

(5) **Insert IC sockets.** Carefully solder a good IC socket in each memory chip location. When you're done, clean the back side of the motherboard with alcohol or a TF degreaser to remove all of the flux left after soldering. Examine the motherboard again for short or broken etch.

(6) **Install new memory chips.** Carefully insert the sixteen 41256 memory chips into the sockets (see Photo 8, page 21).

(7) **Test motherboard.** Before you go any further, check your work by starting up the system. At this point, it should operate as a normal 128K Macintosh. To complete the test, follow these steps:

- Insert the motherboard back into the Macintosh chassis. Connect the display and drive cables to the motherboard, then connect the power cable.
- Start up the system. If all is well, you'll see the normal question-mark disk icon. If the system's diagnostic software finds a problem, it will display a sad icon (or as much of one as it can!). If the system does not start nor-



Proper way to open case: **loosen, but do not remove, all 5 screws with Mac face down. Place screwdriver tip on a screwhead in the top plastic handle of the Mac's case. Press down on the screwdriver, while using your other hand to pull up on the plastic case handle. Pull case straight up. If case still stuck, place screwdriver on head of a screw at bottom of case, near ports. Repeat same procedure: press down on screwdriver shaft, while pulling up on one of the bottom feet with your other hand. Case should lift straight up. *Never pry the case open with any tool!* There is NEVER a reason to pry it open! Remove the metal RFI shield from the ports and set it on top of the case.**

Photo 1

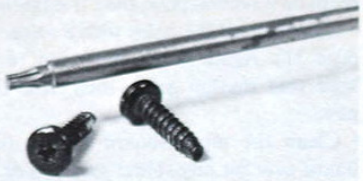
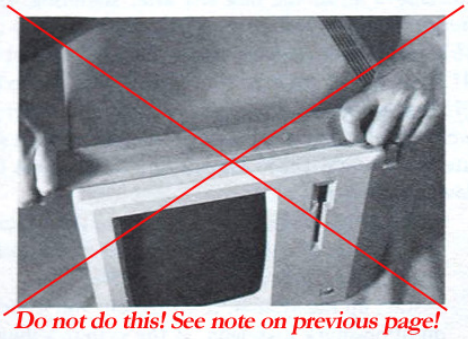


Photo 2



Do not do this! See note on previous page!

Photo 3

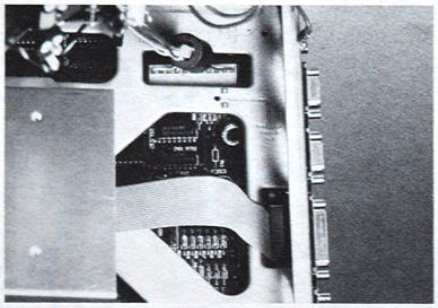


Photo 4

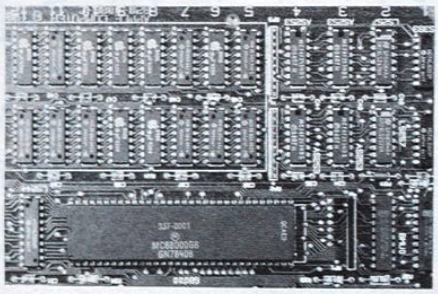
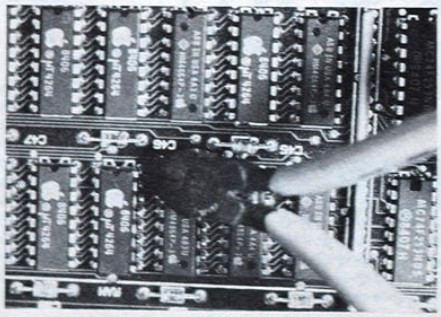


Photo 5



mally, check the trouble-shooting section at the end of this article. *Do not go on to the next step until the system boots up normally.*

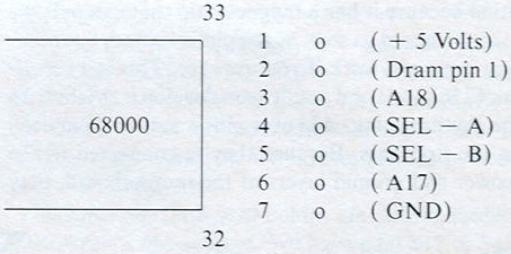
(8) **Remove the motherboard.** Again disconnect the display, disk, and power cables from the motherboard. Ease the motherboard from its connectors and remove it from the chassis.

(9) **Assemble a new memory select IC.** You must build a memory select IC that lets the Macintosh access the extra memory you've just installed. Create the new IC as follows, using Photos 9 and 10 (page 21) and Figures One and Two (page 23) for reference.

- On a good quality 16-pin IC socket, bend out all the pins except 2, 7, 14, and 16.
- Use solder and some small-gauge wire (30 awg) to connect pins 1, 10, 11, 12, and 13 to pin 8.
- Solder a 2.2K 1/4 watt resistor between pins 15 and 16.
- Use solder and some small-gauge wire to connect pins 3 and 4 to pin 15.
- Insert a 74F253 or a SN74AS253 dual 4-to-1 multiplexer into this modified IC socket.

(10) **Install the new memory select IC.** You must connect the new IC assembly to the 68000 address bus, memory select logic, and other lines on the motherboard as follows:

- Mount your new IC assembly on top of the 74F253 (or SN74AS253) located at F3 on the motherboard. Solder pins 2, 7, 14, and 16 of the new IC assembly to the same pins on the 74F253 at F3.
- Locate the seven IC pads at E3, next to pins 32 and 33 of the 68000 microprocessor (see below):



- On the back side of the motherboard, cut the etch between pins 1 and 2 at location E3.
- Solder a 47-ohm 1/4 watt resistor between pin 7 of the new IC assembly and pin 2 of the IC pad at location E3. (See Figure One.)
- Using solder and small-gauge wire, connect pin 5 of the new IC assembly to pin 3 of the IC pads at location E3.
- Using solder and small-gauge wire, connect pin 6 of the new IC assembly to pin 6 of the IC pads at location E3.
- Check the motherboard for any solder splashes, missed wiring, or broken etch. Clean the board with alcohol or a TF degreaser to remove any flux left after soldering.

(11) **Test your FAT MAC!** Insert the upgraded motherboard into the Macintosh chassis. Reconnect the disk, display, and power cables. Power up your Macintosh and check for the normal question-mark disk icon. If your MAC does not appear normal, review the trouble-shooting section at the end of this article. If the normal question-mark disk icon appears, insert your system disk and open the disk copy program. The disk copy program should display a message that

says it only works with a standard 128K MAC. To see how much memory you have, start up BASIC (if you have it) and enter the free memory command: PRINT FRE(0). On our system, BASIC reports about 340K of memory. You may also want to run the MAC memory diagnostics as outlined below for a few hours to check for any long-term problems.

Trouble Shooting

If the system does not start normally, use a multimeter to check that all the connections you've made are connected properly. If all the connections check out, use the system diagnostic program in the Macintosh ROM to determine if

Parts:

Qty.	Part No.	Description	Vendor
16	41256-200	256K 200-ns memory chips	NEC
17		16-pin IC sockets	
1	SN74AS253N or 74F253N	Dual 4-to-1 multiplexer	TI,Motorola Fairchild
1		2.2K 1/4 watt resistor (any resistor from 1K to 4.7K will work)	
1		47-ohm 1/4 watt resistor	

Memory chip vendors:

The first five vendors sell their products retail and have a small or no minimum order; the other vendors are industrial suppliers and may have a minimum order.

Jameco electronics	(415) 592-8097
JDR microdevices	(408) 995-5430
Advance computer products	(800) 854-8230 (714) 558-8822
Jade computer products	(800) 421-5500 (800) 262-1710
DoKay computer products	(800) 538-8800 (800) 848-8008
NARA	(408) 748-9200
TAKA	(415) 952-9000
Japan electronics	(818) 369-1833
D-L-C	(213) 938-2677

Tools:

- Xcelite XTD-10 Torx screwdriver, 6-inch shaft
- Long metal ruler
- Low-temperature soldering iron (Weller WTCPN recommended)
- Solder sucker
- Small-gauge wire (30 awg)
- Multimeter (for problem solving)

Table I.
Supplies Checklist

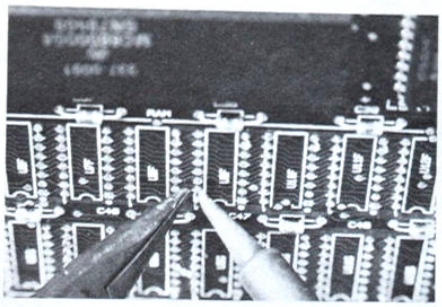


Photo 6

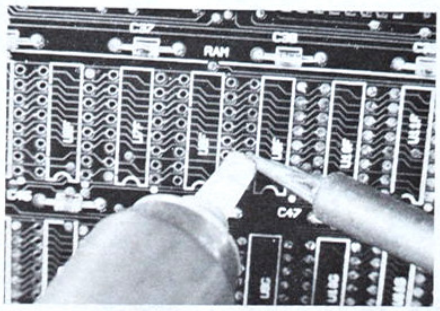


Photo 7

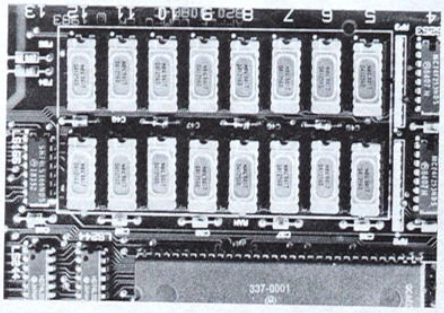


Photo 8

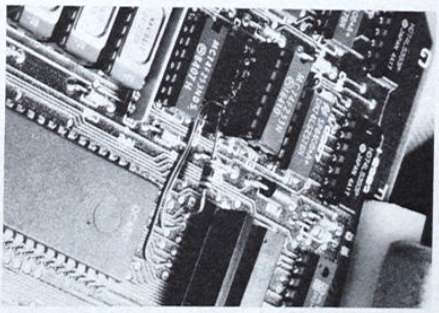


Photo 9

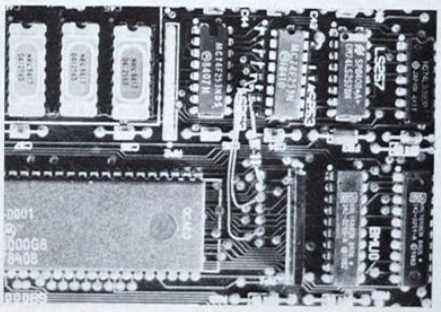


Photo 10

Chip Location	Data Bit Number	Pin 2 to 68000 Pin	Pin 14 to Memory Buffer Pin
F5	D0	5	E12 – 2
F6	D1	4	4
F7	D2	3	6
F8	D3	2	8
F9	D4	1	17
F10	D5	64	15
F11	D6	63	13
F12	D7	62	11
G5	D8	61	E13 – 2
G6	D9	60	4
G7	D10	59	6
G8	D11	58	8
G9	D12	57	17
G10	D13	56	15
G11	D14	55	13
G12	D15	54	11

Table II.
Connections for Pins 2 and 14

Class Code	Sub Code
1 = ROM test failed	Meaningless
2 = Memory test – bus subtest	Identifies bad chips
3 = Memory test – byte write	Identifies bad chips
4 = Memory test – Mod3 test	Identifies bad chips
5 = Memory test – address uniqueness	Identifies bad chips

Table III.
Diagnostic Codes

Data Bit	Location	Sub Code Bits
0	F5	0001
1	F6	0002
2	F7	0004
3	F8	0008
4	F9	0010
5	F10	0020
6	F11	0040
7	F12	0080
8	G5	0100
9	G6	0200
10	G7	0400
11	G8	0800
12	G9	1000
13	G10	2000
14	G11	4000
15	G12	8000

Table IV.
Chip Identification

any of the memory chips you've inserted are bad.

Checking the connections is another repetitive task: you must make sure that all of the 256 new connections you've made carry signal to the appropriate destinations. And most of the connections carry signal to more than one place!

For example, a signal on pin 0 on one memory chip should be connected to pin 0 on every other memory chip. A signal on pin 1 should appear on pin 1 of all the other memory chips. Check for this continuity on all pins except 2, 14, and 15.

Pin 15 is common among chips in the same row. For example, pin 15 on a chip in row F should be connected to every other pin 15 in row F but not in row G. Pin 15 on a chip in row G should be connected to every other pin in row G. Pin 2 on each of the sixteen memory chips is directly connected to one of the sixteen data lines of the 68000 microprocessor. Pin 14 connects the memory chips to the memory buffer circuits at locations E12 and E13.

Table II (at left) shows how pins 2 and 14 should be connected. Each row in the table gives information about one of the memory chips. The first column lists the chip's location. The second column lists the data bit of the 68000. The third column lists the pin on the 68000 to which pin 2 of the memory chip should be connected. The fourth column lists the pin on the memory buffers to which pin 14 of the memory chip should be attached.

If you discover that one of these connections is not connected properly, find and correct the broken etch, or add some small-gauge wire until the connection is restored. If all the connections are in working order and you're still having trouble, use the system diagnostics in the Macintosh ROM to identify the bad memory chips. Look at all signals connected to the suspected chip for a bad connection.

Diagnostics

Before starting the diagnostics, you must have installed the programmer's buttons Interrupt and Reset on the left side of your Macintosh. Hold down the Interrupt button and either press the Reset button or power on your Macintosh.

A sad Macintosh icon appears with a numeric code under it. If all is working well, the code will be 0F 000D, and some small bits will cycle under the code to indicate that the Macintosh is running the memory diagnostic program. The numeric code that you will see has two parts; for example, 0F is the class code and 000D is the sub code. As shown in Table III (at left), the class code tells what part of the diagnostic program found an error, and the sub code tells what the error was. Each of the sixteen bits in the sub code identifies one of the sixteen memory chips. Table IV (at left) maps the sub code bits to their respective chip's location.

If the diagnostics discover more than one bad chip, the sub code displays multiple bits. For example, if bit 3 is bad, the diagnostics display sub code 0008. If both bit 3 and bit 10 are bad, the diagnostics display sub code 0408. If the diagnostics identify a bad chip, you'll have to replace it with a good one or find the problem on the board.

After all the diagnostics have passed, the program displays an exception code giving the current state of your MAC. You should normally see a sub code of 000D, NMI. The others are listed in Table V (at right) for your information only.

Removing the Modification

If you need to convert your Macintosh back into a standard 128K unit, simply remove the IC assembly you added at location F3, remove the sixteen 41256 memory chips, and replace them with standard 200-ns 4164 64K memory chips. You must also connect the jumper at location E3, between pins 1 and 2.

We've completed the conversion on over 10 MACs and have had no problems with this upgrade. So good luck with your new FAT MAC.

DDJ

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	Class Code	Sub Code
F =	Exception	0001 Bus error
		0002 Address error
		0003 Illegal instruction
		0004 Zero divide
		0005 Check instruction
		0006 Traps instruction
		0007 Privilege violation
		0008 Trace
		0009 Line 1010
		000A Line 1111
		000B Other exception
		000C Nothing
		000D NMI (normal indication)

Table V.
Exception Codes

READ.ME

The 256K dynamic RAM chips that turn a Mac into a Fat Mac are very sensitive to static electricity. Please note the following advice on handling 256K RAMs, adapted from information from John Gilchrist of Microprocessors Unlimited in Beggs, Oklahoma.

To damage a true LSI device like a 256K RAM chip, you don't have to touch it. Being close to it with a high potential voltage on your body will do the job. You can, for example, generate 3000 volts by walking across a carpet in leather shoes or by peeling off a foot or so of cellophane tape, and you won't feel a thing as the tiny spark jumps to the IC, doing its hidden damage.

Following these steps should lessen the risk to the chips from static electricity.

1. If you have a choice of workspace, almost any floor covering is better (for the present purpose) than carpeting.
2. Take off your shoes. Don't take this as a personal remark, but your feet sweat enough to make it unlikely that a high static charge can build up when you are standing barefoot on a noncarpet surface. And don't wear any nylon clothing.
3. Spread out a large sheet of aluminum foil (about a three-foot length) and work on that. Wrap a corner of the foil around the Mac chassis or motherboard and poke the computer's power cord through the foil. Keep your body (e.g., one elbow) on the foil throughout the process of preparing the Mac to receive its new chips.
4. Don't handle the 256K chips until, or any more than, you have to. When you are ready for them, slide the chips out of their factory tube onto the foil. Keep your body in constant contact with the foil as you install the chips.
5. When you've finished the installation and are ready to test your work, be sure to remove the wall plug from the foil before plugging it into the wall. Otherwise you could fry more than a chip.

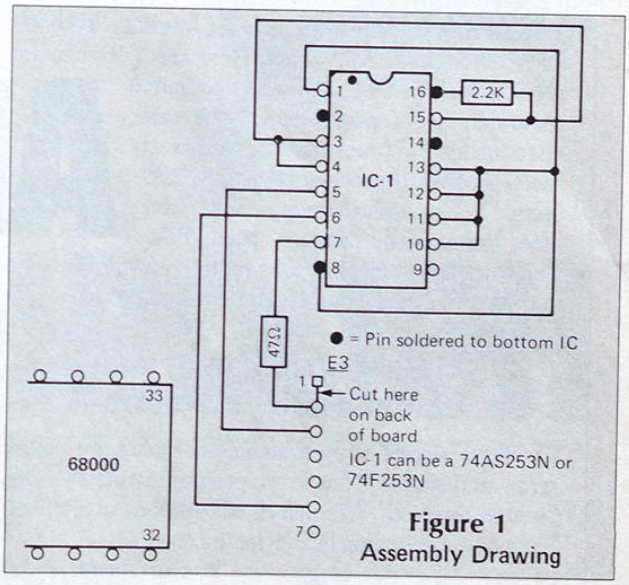

Figure 1
Assembly Drawing

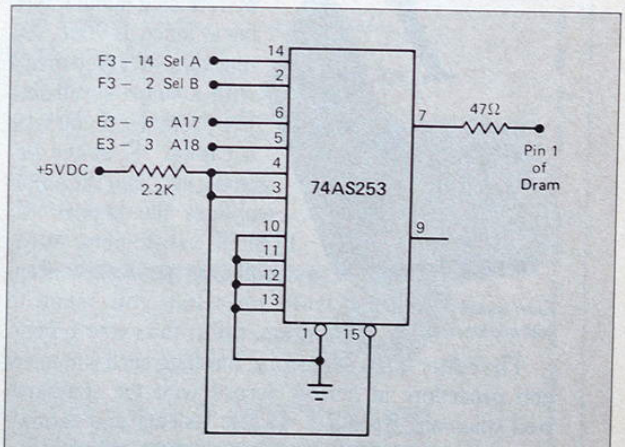

Figure 2
Logic Drawing

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CONTENTS

Prolog

A year ago when we were still being published by the old *People's Computer Company* in Menlo Park, I asked Mike Swaine if Artificial Intelligence was, by definition, beyond the scope of microcomputers. What resulted from that Sunday afternoon brainstorming session was the AI programming competition and this special issue.

As the programs and manuscripts rolled in we found ourselves building the issue around Prolog and we wished for a public domain tiny-Prolog to publish. We haven't found that yet, but we did get some very good Prolog pieces. Future issues of *DDJ* will include responses from Lisp people.

Speaking of future issues: June is the special telecommunications issue, as well as the copy deadline for the annual algorithms issue which will run in September. The annual Forth issue which usually runs in September will appear in October. Please submit Forth material by the Fourth of July.

Reader Ballot Results

Despite the popularity of our December 1984 focus on Unix, the article voted best in the Unix issue was not a Unix piece. Henry Seymour's "An Introduction to Parsing" received twice as many "best article" votes as the second most popular article, Alan Walworth's "Varieties of Unix." By the way, may we assume that because nobody challenged the Unix family tree on page 35, we got it right?

Mac Erratum

In the January Fatten Your Mac article, there is a discrepancy between the text on page 20 and Figure 1 on page 23. The figure correctly shows pin 8 soldered, but the text refers to pin 7 of the memory select IC. Readers who have called to point out the error inform us that the error in the text is obvious to anyone who works through and understands the article and the figures. We hope so.

This Month's Referees

Dave Cortesi, Resident Intern
Neil Jacobstein, Teknowledge
Scott Mace, Free-lance Computer Writer
Paul Reinholdtsen, Stanford University
Pekka Sinervo, Stanford Linear Accelerator

Randy Sutherland
Editor

Chubby Mac

Dear *DDJ*,
I would like to congratulate you for the excellent January [1985, #99] issue of *Dr. Dobb's* featuring "Fatten Your Mac" by Tom Lafleur and Susan Raab. Thanks to that article, I was able to upgrade my Mac for much less than Apple's list price: I paid $200 total or around $11 per memory chip.

Having never seen a hardware technical manual for the Mac that's equivalent to "Inside Macintosh" for software, I found the diagnostics part of the article very useful. While doing the upgrade, I encountered socket connection problems that were solved by following the continuity test procedure mentioned.

Do you know what dealers or customers do with the 128K boards, for those who upgrade their boards the official Apple way? I was thinking that if I decide to pursue this and upgrade Macs for friends and for money, I will probably need some extra 128K boards as a safety net. If you know people who have a 128K board that they are going to throw away, let me know.

I am so happy to have a 512K Mac now that I decided to enter a 1-year subscription to *Dr. Dobb's*. Once again, congratulations to *Dr. Dobb's* and the authors.

Sincerely,
Tho AuTruong
908-B Menlo Avenue
Menlo Park, CA 94025

PUBlic Service

Dear *DDJ*,
A minor correction is needed to our article "CP/M 2.2 Goes Public (November, 1984, #97)". In Listing 2, page 70, the PUBLIC.ASM utility to set or reset the PUBlic file attribute bit contains a bug, discovered by Greg Platt, that prevents it from making very large files PUBlic.

Here's the fix; Update the version equate to read:

```
vers    equ     1$1
```

and insert the following code in the SAMEXT routine preceeding its "ret" instruction:

```
    rnz         ; v 1.1
    inx   h     ;extent is 0,
                  check  overflow  (s2)
                  ext.
    inx   h
    mov   a,m
    ani   7fh
;
    ret         ;end of SAMEXT
                  routine
```

PUBPATCH—the BDOS patch that implements PUBlic file processing—is unaffected by the bug.

Sincerely,
Bridger Mitchell
Derek McKay
Plu*Perfect Systems
Box 1494
Idyllwild, CA 92349

Dear *DDJ*,
The article "CP/M 2.2 Goes PUBlic" by Mitchell and McKay, in your November [1984, #97] issue was most informative and useful. However, the code text published with it had a few problems. Some specifics from Listing One: the location definitions CKFILPOS and SETSTAT were multiply defined (to be sure, the definitions were the same, but still rather irregular); 'nxbyt:' was referenced both as itself and 'nxtbyte', typo or program error I can't tell, since only the first six characters are frequently used. More serious was the use of a font in which both lower case 'L' and the number one used the same representation. This is common on typewriters, but rare on computer printers. Line 253 is definitely ambiguous as printed, although it can be deciphered in context.

At any rate, I was able to enter the program text, make the necessary corrections, translate it to true Z80 code, and assemble it with the Z80MR assembler from MicroCornucopia. Installation under ZCPR3 required a little research to find the correct addresses, but they were there. Thus I no longer need to have long text files in the same user area as my PW or WS editor; this is a real convenience in the rather crowded directories on my Kaypro10. My sincere thanks to the authors!

Gratefully
Bonnell Frost
5559 Colt Drive
Longmont, CO 80501

Grep Again

Dear *DDJ*,
A belated thank you for grep.c [*DDJ* #96, October 1984], which I finally got around to typing in and compiling on my Osborne 1 with C/80.

C/80 Version 3.0 from The Software Toolworks will not compile grep.c as listed because it has no:

a) linker
b) typedef statement
c) FILE type
d) #defined NULL
e) stdin
f) stdout
g) stderr
h) fgets
i) stdio.h
j) capability to call a function with a different number of

LETTERS

Anorexia Cured

Dear *DDJ*:

I read with some interest the article 'Fatten Your Mac' that appeared in your January [1985, #99] issue and forthwith did a fattening on my Macintosh. There are a number of points that I would like to add to the article, however. Firstly, a fine supplier of the 256K DRAM chips was omitted. I refer to Microprocessors Unlimited, of Beggs, Oklahoma, (918) 267-4961. I was able to phone them late Friday, and the chips they sent out on Monday arrived here (in Seattle) on Tuesday. I was quite pleased with the price and the service. They accept Visa, and they even sent a brief note explaining proper handling of the chips.

Secondly, it is *not* necessary, though it may be desirable, to destroy the 64K DRAM chips. I desoldered the original chips with an Ungar model 2000 desoldering tool, and was able to remove the solder, let the board cool, then pry the chips from the motherboard, all without clipping a single lead. This damaged two printed circuit traces (pulled them off in the prying process); as the article recommends, *there is a safer way to proceed*. My technique cannot be advised in the absence of an excellent desoldering tool, or for those not confident in their abilitites to make printed circuit repairs. The article had so fired my enthusiasm that I yanked out the 64K DRAMs days before the 256K DRAM circuits arrived. I was able to verify the repairs, and the removed memory chips, by installing sockets, plugging the 64K DRAMs into those sockets, and using the Macintosh. The nature of the lifted printed circuit traces (they showed copper color on the ICs to which the traces stuck) made detection easy, and no faults were missed. The board worked on the first try.

Thirdly, the multiplexer can be installed either piggybacked on another chip, or can be placed on a separate board, attached on the seven solder pads referred to in the article. Those seven pads include all logic signals and power required for the multiplexer. I installed wire-wrap pins in those pads, made a small board for the multiplexer from .100-inch hole-grid breadboard material, and pushed the small board over the wire-wrap pins, wire-wrapping the connections atop it to hold it in place. I found this less tricky than the piggyback soldering job would have been, and no leads of the multiplexer needed to be bent.

Fourthly, the multiplexer recommended is 74F253 or 74AS253; while these will do quite well, so will the 74F153 or 74AS153; which are slightly less expensive; the only difference is the nature of the DISABLE function, which (in this application) is always unused. All pin connections are identical to the '253.

I found that the multiple-layer board, having extra copper in the interior layers, was rather more difficult than most to desolder; I had to apply more heat (use a higher temperature on the desoldering iron) than usual, to complete the solder removal within a safe time. I did not notice any fragility of the printed circuit (no more than most, at any rate), and my procedure was, as I have mentioned, rather stressful. At one point, I fumbled, and dropped the board onto the concrete floor—there was no damage.

Prices were better than I expected, about $220 total cost for the chips, and that figure is dropping almost daily. Time required was almost exactly four hours. Since Apple charges about six hundred dollars more for the 512K Mac, it hardly pays to buy one; the fine folks in Cupertino are willing, in effect, to pay me handsomely for those hours, if I convert my 128K instead.

Instead of 'Macintosh' and 'Fat Mac', I will be using the terms 'Macintosh' and 'Anorexic Mac' in the future.

Sincerely grateful,
John Whitmore
FM-15 Physics Dept.,
University of Washington
Seattle, WA 98195

Going PUBlic

Dear *DDJ*:

PUBlic files have been used successfully on a wide variety of CP/M computers since the publication of our November 1984 [*DDJ*, #97] article "CP/M 2.2 goes PUBlic." However, we want again to caution readers that PUBPATCH must be installed on an *unmodified* CP/M 2.2 BDOS!

Several users have discovered that their Heath Co. CP/M 2.2.03 has been altered with a patch at 06E1 and 0DEE–0DF3 (relative to the start of the BDOS). The Heath patch causes the BDOS to stop building the disk group-allocation vector when it encounters the first directory entry having deleted data (E5) codes in both bytes 0 and 1. If PUBPATCH is then installed in this BDOS, the symptoms will be files that disappear from the end of the disk directory!

Heath users with this problem should patch location 06E2h back to its original value '06D2h' (relative) before installing PUBPATCH.

RELATIVE ADDRESS	06E1'
ORIGINAL 2.2 BDOS	JZ 06D2'
HEATH 2.2.03 BDOS	JZ 0EEE'