

## Diagnostics—The “Sad Mac” icon

### On the original ROMs (128k, 512k, 512ke, Plus):

When you press the interrupt button on the side of your Macintosh when booting, you should get a sad Mac icon with '0F000D' and some bits cycling under the icon indicating it is performing a memory test.

This numeric code is in two parts: the first two characters are the class code and the second four are the sub code. The class code tells what part of the diagnostic program found the error and the sub class code tells what the error was. In the case of a bad RAM chip, the sub class identifies the bad chip (this was very helpful to homegrown upgraders).

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#### Class Code

1 = ROM test failed

2 = Memory test - bus subtest

3 = Memory test - byte write

4 = Memory test - Mod3 test

5 = Memory test - address uniqueness

#### Sub Code

Meaningless

identifies bad chips

identifies bad chips

identifies bad chips

identifies bad chips

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### Single Chip Identification

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

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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)
- 0064 Couldn't Read System File into Memory

**Macintosh SE & Macintosh II ROMs:**

The Sad Mac error codes have been changed to incorporate additional power for testing and to support the 32-bit world. Generally, the same codes are used for 68000 exceptions as the Macintosh, however they are displayed differently.

The traditional Macintosh error codes are displayed like this:



0F0003

Where “F” indicates an exception occurred, and “3” indicates an illegal instruction occurred. On the Macintosh SE and II, the display would appear:



0000000F  
00000003

Please note that 00000003 is a hex number.

The new power-on error codes have the following format:



XXXXYYYY  
ZZZZZZZZ

Where XXXX is internal test manager state information (ignore this), YYYY contains codes that indicate either an exception code, or the test number for a power on test failure. The ZZZZZZZZ code contains additional failure information to help track down the problem.



DD=8 bit mask for bits 7-0

\$0003	The RAM test failed while testing bank B, after passing the chunk tested code \$0002. The Z field indicates which bits failed as in code \$0002.	for
\$0004	The RAM test failed while testing bank A. The Z field indicates which bits as in code \$0002.	failed
\$0005	The RAM External addressing test failed. The Z field indicates a failed line.	address
\$0006	Unable to properly address the VIA1 chip. The Z field is not applicable.	
\$0007	Unable to properly address the VIA2 chip (Macintosh II only). The Z field is not applicable.	
\$0008	Unable to properly access the Front Desk Bus. The Z field is not applicable.	
\$0009	Unable to properly access the MMU. The Z field is not applicable.	
\$000A	Unable to properly access NuBus. The Z field is not applicable.	
\$000B	Unable to properly access the SCSI Chip. The Z field is not applicable.	
\$000C	Unable to properly access the IWM chip. The Z field is not applicable.	
\$000D	Unable to properly access the SCC Chip. The Z field is not applicable.	
\$000E	Failed Data Bus test. The Z field indicated the bad bit(s) as a 32-bit mask 0-31. This may indicate either a bad SIMM or data bus failure.	for bits
\$000F	Reserved for Macintosh compatibility.	
\$FFxx	A 680xx exception occurred during power on testing. The xx indicates the exception:	

\$01 — Bus Error

- \$02 — Address Error
- \$03 — Illegal Instruction Error
- \$04 — Zero Divide
- \$05 — Check Instruction
- \$06 — cpTrapCC, Trap CC, Trap V
- \$07 — Privilege violation
- \$08 — Trace
- \$09 — Line A
- \$0A — Line F
- \$0B — unassigned
- \$0C — CP protocol violation
- \$0D — Format exception
- \$0E — Spurious interrupt
- \$0F — Trap 0–15 exception
- \$10 — Interrupt Level 1
- \$11 — Interrupt Level 2
- \$12 — Interrupt Level 3

\$13 —

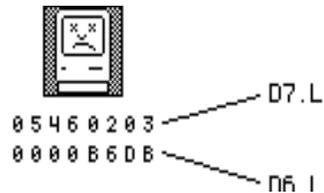
Interrupt Level 4

- \$14 — Interrupt Level 5
- \$15 — Interrupt Level 6

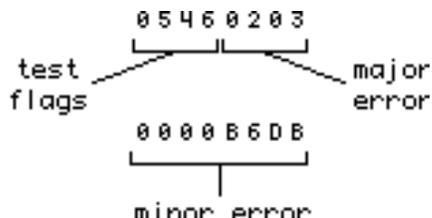
- \$16 — Interrupt Level 7
- \$17 — FPCP bra or set on unordered condition
- \$18 — FPCP inexact result
- \$19 — FPCP divide by zero
- \$1A — FPCP underflow
- \$1B — FPCP operand error
- \$1C — FPCP overflow
- \$1D — FPCP signalling NAN
- \$1E — PMMU configuration
- \$1F — PMMU illegal operation
- \$20 — PMMU access level violation

## Macintosh Portable ROMs:

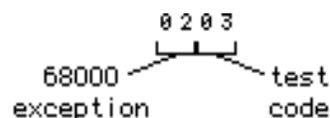
The bootup code in the Macintosh Portable contains a series of startup tests that are run to ensure that the fundamental operations of the machine are working properly. If any of those tests fail, a Sad Mac icon appears on the screen with a code below that describes what failure occurred. Here is a typical example of a Sad Mac display with an error code below it:



The two codes are actually the contents of the two CPU data registers D6 and D7. The upper word (upper 4 hex digits, in this case 0546) of D7 contains miscellaneous flags that are used by the start-up test routines and are unimportant to just about everybody except a few test engineers within Apple. The lower word of D7 is the major error code. The major error code identifies the general area the test routines were in when a failure occurred. D6 is the minor error and usually contains additional information about the failure, something like a failed bit mask.



The major error is further broken into the upper byte that contains the number of 68000 exception that occurred (\$00 meaning that no exception occurred), and the lower byte that usually contains the test that was being run at the time of failure. If an unexpected exception occurred during a particular test, then the exception number is logically ORed into the major error code. This way both the exception that occurred as well as the test that was running can be decoded from the major error code:



In this example, the code says that an address error exception (\$0200) occurred during the RAM test for Bank A (\$03); \$0200 ORed with \$03 = \$0203.

### **Major error codes**

Below is a brief description of the various test codes that might appear in the major error code:

- ® **Warning:** Some of these codes may mean slightly different things in Macintosh models other than the Macintosh Portable.

## These descriptions describe specifically how they are used in the Macintosh Portable.

- \$01 - ROM test failed. Minor error code is \$FFFF, means nothing.
- \$02 - RAM test failed. Minor error code indicates which RAM bits failed.
- \$05 - RAM external addressing test failed. Minor error code indicates a failed address line.
- \$06 - Unable to properly access the VIA 1 chip during VIA initialization. Minor error code not applicable.
- \$08 - Data bus test at location eight bytes off of top of memory failed. Minor error code indicates the bad bits as a 16-bit mask for bits 15–00. This may indicate either a bad RAM chip or data bus failure.
- \$0B - Unable to properly access the SCSI chip. Minor error code not applicable.
- \$0C - Unable to properly access the IWM (or SWIM) chip. Minor error code not applicable.
- \$0D - Not applicable to Macintosh Portable. Unable to properly access the SCC chip. Minor error code not applicable.
- \$0E - Data bus test at location \$0 failed. Minor error code indicates the bad bits as a 16-bit mask for bits 15–00. This may indicate either a bad RAM chip or data bus failure.
- \$10 - Video RAM test failed. Minor error code indicates which RAM bits failed.
- \$11 - Video RAM addressing test failed. Minor error code contains the following:
 

word	=	failed address (16-bit)	upper
lower word	=	data written	msb of
lower word	=	data read	lsb of

Data value written also indicates which address line is being actively tested.
- \$12 - Deleted
- \$13 - Deleted
- \$14 - Power Manager processor was unable to turn on all the power to the board. This may have been due to a communication problem with the Power Manager. If so, the minor error code contains a Power Manager error code, explained in the next section.
- \$15 - Power Manager failed its self-test. Minor error code contains the following:
 

msw	=	error status of transmission to power manager .
lsw	=	Power Manager self-test results (0 means it passed, non-zero means it failed)
- \$16 - A failure occurred while trying to size and configure the RAM. Minor error code not applicable.

### Minor error codes—Power Manager processor failures

If a communication problem occurs during communication with the Power Manager, the following error codes will appear somewhere in the minor error code (usually in the lower half of the code, but not always):

- \$CD38 Power Manager was never ready to start handshake.
- \$CD37 Timed out waiting for reply to initial handshake.
- \$CD36 During a send, Power Manager did not start a handshake.
- \$CD35 During a send, Power Manager did not finish a handshake.

\$CD34

During a receive, Power Manager did not start a handshake.

\$CD33        During a receive, Power Manager did not finish a handshake.

### **Diagnostic Code Summary**

Below is a summarized version of the Sad Mac error codes:

#### Test Codes

\$01	ROM checksum test.
\$02	RAM test.
\$05	RAM addressing test.
\$06	VIA 1 chip access.
\$08	Data bus test at top of memory.
\$0B	SCSI chip access.
\$0C	IWM (or SWIM) chip access.
\$0D	Not applicable to Macintosh Portable. SCC chip access.
\$0E	Data bus test at location \$0.
\$10	Video RAM test.
\$11	Video RAM addressing test.
\$14	Power Manager board power on.
\$15	Power Manager self-test.
\$16	RAM sizing.

#### **Power Manager communication error codes**

\$CD38	Initial handshake.
\$CD37	No reply to initial handshake.
\$CD36	During send, no start of a handshake.
\$CD35	During a send, no finish of a handshake.
\$CD34	During a receive, no start of a handshake.
\$CD33	During a receive, no finish of a handshake.

#### **CPU exception codes (as used by the startup tests)**

\$0100	Bus error exception code
\$0200	Address error exception code
\$0300	Illegal error exception code
\$0400	Zero divide error exception code

\$0500	Check inst error exception code
\$0600	cpTrapcc, Trapcc, TrapV exception code
\$0700	Privilege violation exception code
\$0800	Trace exception code
\$0900	Line A exception code
\$0A00	Line F exception code
\$0B00	Unassigned exception code
\$0C00	CP protocol violation
\$0D00	Format exception
\$0E00	Spurious interrupt exception code
\$0F00	Trap inst exception code
\$1000	Interrupt level 1
\$1100	Interrupt level 2
\$1200	Interrupt level 3
\$1300	Interrupt level 4
\$1400	Interrupt level 5
\$1500	Interrupt level 6
\$1600	Interrupt level 7