EXTERNAL SPECIFICATION
(User Perspective)

TITLE : Sky diagnostic FFPUSR External Specification

AUTHOR : Sunny Kirsten

REPORT NO. :

REVISION NO. : @(#) ffpusr.txt 1.11 3/21/85

DATE : July 2, 1985

STATUS : Draft

APPROVALS : DATE

Originator: Sunny Kirsten ----------

Test Engineering ----------

Manufacturing ----------

Production ----------

Quality Control ----------

Document Review Form

Please make note and initial on this page all corrections and/or proposed amendments by page number and/or section number.

Recommendations, Differences, Construction Errors, and comments:

Typographical Errors:

Attach additional sheet(s) as needed.

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Purpose The Sky board diagnostic FFPUSR is a component of SYSDIAG, and is used as a UNIX-based board test. It is a quick Go/NoGo test of the Sky board hardware. It is not intended to thoroughly exercise the Sky microcode, but instead focuses on functional testing of sufficient level as to reject an obviously bad piece of hardware.

1.2. Applicable Documents The Sun document 800-1104-01 describes the Sky board, and its installation in a Multibus system, and tells something of the Sky version of FFPUSR, and associated software. This document is not needed to operate the program, though it would be useful if you wanted to decipher hardware bit patterns mentioned in error messages, to isolate problems within the Sky board. Since Sun does not repair these boards in-house, internal fault isolation is not intended.

1.3. Definitional Conventions

1.3.1. Notations FFP is an acronym for Fast Floating Point

1.3.2. Syntax

1.3.3. Terminology

2. SYSTEM OVERVIEW

2.1. General Description The Sky board diagnostic FFPUSR is a Sun customization of the Sky supplied f77 program FFPUSR. The modifications by Sun added code to allow operation in a Go/No-Go environment, where the amount of user interaction was to be minimized, rather than the full manual control offered by the version supplied by Sky.

2.2. Features This program is typically used in board level test by executing the FFPUSR command a (Auto), for automatic test of the basic math functions, and simple context switch operations. The system level test SYSDIAG uses FFPUSR with the commad d (Diagnose) in the devtest section.

2.3. Required Configuration The required configuration is a Sun system with one Sky board. Installation details are contained in the referenced documentation. Note that for Multibus, the connections on JP-01 should be 1-11, and on JP-02 should be 1-3-6 and 4-5. For actual use in a UNIX system, the file /dev/sky must exist. The file /dev/sky must be removed for FFPUSR to operate correctly. If /dev/sky exists, UNIX will believe it has use of the board. When you run FFPUSR, it thinks it has use of the board. If both occur simultaneously, then they will interfere with each other and the result will be a system crash.

2.4. Error Handling Errors are reported in messages directed to stdout. Testing continues.

2.5. General Performance Characteristics The test will typically take on the order of 6 minutes to complete one error-free pass.

2.6. Planned Extensions For board-test usage, ffpusr will be replaced by skytest, a stand-alone program, not requiring UNIX as the current test does.

2.7. Limitations The existing test exercises only single precision add, subtract multiply, divide, and sine math functions, along with a simple "between-operations" context switch. The program allows 1 bit of difference between the answers produced by the Sky board, and those of UNIX' floating point libraries. It further allows 5e bits difference in the sine function. It also contends with the Sky board's handling of underflow towards zero.

3. . SPECIFICATION

3.1. User Interface The user interface is based on menus and simple, one character commands. The program prompts with a "?". If the user replies with a "?", the program will display a command menu. Since this is an extension of the Sky code, it includes all the low-level bit-fiddling commands Sky provided. The main command used by Sun is "a" for automatic testing which will produce error messages for any detected errors, and which produces a performance summary for each math operation, at the end of the test. This command may be used only once per invocation of the program.

3.2. Input/Output Stdin and stdout are used for commands and program responses. The program will expect to find the microcode files in the current directory.

3.3. Operation Login as root, rm /dev/sky, cd to the directory containing FFPUSR. Enter the command "ffpusr", and once the program loads and prompts with a "?", enter the command "a" to start the test. After testing the registers, and then the RAM, the program will load the microcode into the board, and then test math functions, completing with a summary of bit differences between the Sky board and the UNIX floating point library. It is normal to see the entry "1" for all the functions add, subtract, multiply, and divide. Sine, however, may be up to 0x5e. If any of these had been overlimit, there would have been error messages produced previously with full details.

3.4. Error Handling Errors are reported in messages directed to stdout. Testing continues.

3.5. Performance Performance is minimal, but sufficient to reject a truly bad board.

APPENDIX

4. APPENDIX SECTION

valid function codes are:

? = help (display this table)
h = help (display this table)
a = automatic GO/NOGO diagnostics
d = Diagnose for SysDiag
r = register diagnostics
m = memory diagnostics
l = load ascii microcode into ffp
i = initialize the ffp
t = test selected math functions
e = execute a pio sequence
p = pio communication
f = do a spfp ffp function
s = do a special function
b = base address modifier
c = user context swap
q = quit - return to o.s.

INDEX

5. INDEX SECTION

SUN Microsystems

Sky FFP Board Diagnostic

User's Document

Sunny Kirsten

July 2, 1985

Revision A

Contents

1. Preface

The Sky Board Diagnostic User's Guide is presented.

1.1. Purpose

The purpose of this document is to describe the Sky board program (*sky.diag*). This diagnostic serves as the primary tool in determining the functionality of the Sky FFP Board.

The intention of this release is to give a detailed description of each test.

1.2. Audience

Members of any of the following departments may find this document of interest for various reasons: (1) Design Engineering, (2) Manufacturing, (3) Field Service, (4) Diagnostics, (5) Training and (6) Documentation.

2. Revision History

Revision A 85/06/04 Intial release of this document.

3. Glossary

sky.diag - Sky Board Diagnostics.

FFP - Fast Floating-Point Processor

4. References

For further information on the Sky Board hardware please refer to:

I. *Sky Fast Floating-Point Processor System Integration Manual p/n 800-1104-01*

This Sky document describes the Sky board, and its installation in a Multibus system. It would be useful if you wanted to decipher hardware bit patterns mentioned in error messages, to isolate problems within the Sky board. Since Sun does not repair these boards in-house, internal fault isolation is not intended.

II. *System Internals Manual for the Sun Workstation p/n 800-1117-01*

This Sun document contains a section on the CPU PROM Monitor, which is used to boot the diagnostic.

5. Introduction

Sky.diag is a standalone diagnostic program used as a stand-alone board test. It is a quick Go/NoGo test of the Sky board hardware. It is not intended to thoroughly exercise the Sky microcode, but instead focuses on functional testing of sufficient level as to reject an obviously bad piece of hardware.

6. Hardware Requirements

The minimum hardware configuration required is listed below.

1. A Sun Workstation model 100U, 150, 120, 170, 160, or 50.
2. A Sky FFP board

7. Software Requirements

Sky.diag is a standalone diagnostic. It does not run with the UNIX operating system.

8. Booting Instructions

This section gives an example of how to boot and run *sky.diag*. If *UNIX* is running, use /etc/shutdown, /etc/halt or /etc/fasthalt to shut it down. The ">" monitor program prompt is displayed.

To boot *sky.diag* from SCSI disk issue the following prom monitor command:

bsd() stand/sky.diag

To abort *Sky.diag* enter either L1 -a or BREAK, and to start it again enter "*g4000*".

The **Cpu Prom Monitor** manual contains more detailed directions for booting from devices.

Upon booting, *sky.diag* identifies itself with:

"@(#)sky.diag.c 1.27 85/05/09 Copyright Sun Microsystems"

and a line indicating which type of bus the program thinks it's executing on:

"StandAlone Sky Fast Floating Point Processor Board Diagnostic (Multibus)"

or

"StandAlone Sky Fast Floating Point Processor Board Diagnostic (VME-bus)"

Then the program attempts to locate a Sky board on the bus, and if it fails:

"sky.diag:can't find Sky board! Check configuration."

Check the jumpers on the Sky Board versus the Sky Manual. The diagnostic will only test one board in any system.

8.1. User Interface

The program interacts with the user via the standard system console using simple ASCII prompts and replies. Typically this will be the Sun video and keyboard, but on systems which have no video board, and which instead used a dumb terminal configured as the console, this will work also.

8.1.1. Parameters

Sky.diag next prompts for the number of passes to run.

"How many passes? (CR=5; 0=forever): "

Respond with a "**<carriage-return>**" to test for 5 passes.

Respond with a "**0<carriage-return>**" to test forever.

Respond with a "**n<carriage-return>**" to test for **n** passes.

The test proceeds to try to load microcode into the board's RAM, and if it fails it displays:

"sky.diag:ucode verify error +0x%x exp(0x%x) obs(0x%x)"

where +0x%x is a hexadecimal number showing the address offset from the beginning of the microcode,

where exp(0x%x) is a hexadecimal number showing the expected data,

where obs(0x%x) is a hexadecimal number showing the observed data,

"sky.diag:microcode load FAILED"

If the load succeeds, the message indicated is:

"sky.diag:loaded n words of ucode"

8.1.2. Test

Then the program indicates the pass count and begins looping for the number of passes specified:

"sky.diag:0"

If a failure occurs, after displaying details of the secific error, the program displays this message and quits:

"sky.diag:FAILED on pass n"

If the test finds no errors before reaching the specified pass count, the program displays this message and quits:

"sky.diag:n passes PASSED"

The test loops in a cycle of performing a context restore/save operation followed by a series of math operations.

The beginning of the context test is indicated by the message:

"context restore/save"

If this fails, these messages indicate the details:

"FAILED

0x%x exp(0x%x) obs(0x%x)"

where exp(0x%x) is a hexadecimal number showing the expected data,

where obs(0x%x) is a hexadecimal number showing the observed data,

"sky.diag:context restore/save FAILED"

If the program has difficulty getting the board to respond during a test, the following message will be displayed:

"sky.diag:skyop timed out on 0x%x opcode"

where exp(0x%x) is a hexadecimal number showing the expected data,

where obs(0x%x) is a hexadecimal number showing the observed data,

where skyop is a routine used by the rest of the test to genericaly execute a math operation via the sky board.

The math operations performed are, Log, Add, Subtract, Multiply, and Divide, all in single precision. As each cycle of 256 math operations of each type is started, the type of operation is indicated with:

"LOG ADD SUB MUL DIV "

If the log operation fails, the nature of the failure is indicated:

"timed out on log(1.0) read"

"sky.diag:hung in I/O busy state: FAILED"

"FAILED on log(1.0) (0x%x)"

where (0x%x) is a hexadecimal number showing the observed data, when 0 was expected

"sky.diag:FAILED on logarithm of 1.0"

If the math operation from the set Add, Subtract, Multiply, Divide fails:

"op = 0x%x FAILED"

where 0x%x is the hexadecimal operation code, detailed in the Sky manual. The operation is also displayed in english as (log, add, sub, mul, or div)

"sky.diag:argument 1 argument 2 s software h hardware"

"sky.diag:0x%x 0x%x s 0x%x h 0x%x"

"sky.diag:FAILED on single precision arithmetic"

where 0x%x is a hexadecimal number where the operation was (argument 1) op (argument 2) where s=software results of the operation where h=hardware results of the operation

9. Error Handling

All errors are considered terminal, i.e. the test will output an error message and quit.

9.1. Message Interpretation

Error messages include enough english text to indicate which function of the board failed.

9.2. Failure Analyses

Log the error message to include with the board when it is returned to Sky.

9.3. Field Replaceable Units

The entire Sky FFP board is the Field Replaceable Unit. The board is ultimately sent to Sky for repair.

10. Recommended Test Procedure

In an incoming inspection environment, the typical usage will be to use the default 5-pass test.

11. Future Considerations

Beta testing has indicated sufficient coverage by the existing diagnostic to sort out the bad boards on incoming inspection.

12. Summary

The Sky Fast Floating-Point Processor Board Diagnostic "**sky.diag**" is a fast and simple test of the overall functioning of either the Multibus or VME-bus version of the Sky board used in Sun's Sun-1 and Sun-2 architecture machines.

TEST PROCEDURE

TITLE : Sky FFP Test Procedure

PART NO. :

REVISION NO. : 1.7

DATE : 3/7/85

APPROVALS : DATE

Originator Sunny Kirsten ----------

Test Engineering ----------

Manufacturing Engineering ----------

Production ----------

Quality Control ----------

Engineering ----------

TABLE OF CONTENTS

Document Review Form

Please make note and initial on this page all corrections and/or proposed amendments by page number and/or section number.

Recommendations, Differences, Construction Errors, and comments:

Typographical Errors:

Attach additional sheet(s) as needed.

1. INTRODUCTION

1.1. Device Under Test The Sky Fast Floating Point Processor board performs math functions in a multi-user environment. The diagnostics are designed to test the basic hardware functionality, not all the intricacies of the microcode used by the board.

2. TEST DESCRIPTION

2.1. General Description The Sky diagnostic FFPUSR is used to perform a basic functional evaluation of a sky board. It runs on top of UNIX in Root (SuperUser) mode.

2.2. Features The Sky diagnostic will test with the microcode file **sky.ucode**, which must either exist in the same directory as the Sky diagnostic code *ffpusr*, or should be a link to **/etc/sky.ucode**.

2.3. Required Configuration First the hardware configuration must be correct. On a Multibus system, there are a couple of jumpers on the board which must be checked, in jumper blocks JP-01 and JP-02. On JP-01 the connections should be 1-11. On JP-02 the connections should be 1-3-6 and 4-5. On a model 120 the sky board is installed in slot 8, and on a model 170 the sky board is installed in slot # 11. The Sky board does not share the SUN P2 bus, so in a 100U or 150U install the Sky board in a slot other than 2, 3 or 4, such as 5 or 1. On a model 160 the sky board is installed in the upper pair of connectors of the 3 connectors of the VME bus.

Before the FFPUSR program is executed, the operator should be root or super-user on the UNIX system to be used, and should remove the file /dev/sky:

```
host# rm /dev/sky
```

It is possible to crash a UNIX system by yanking /dev/sky out from under it, if it's active at the time, by causing a buss error. Thus it is best to do the rm just after booting.

It is necessary to connect to the directory containing the files for the Sky test:

```
host# cd /usr/diag/sysdiag
```

and, if **sky.ucode** doesn't exist there, use the command:

```
host# ln -s /etc/sky.ucode
```

2.4. Error Handling Error messages are directed to stdout. Testing continues after errors. A statistical summary of performance is output to stdout at the end of the test. The test is a one-pass Go/No-Go test which does not loop. Use of this test in a looping mode is performed most easily with the "devtop" command, which is part of SysDiag.

2.5. General Performance Characteristics The program has been set-up to accept the Sky board's handling of underflow towards zero, and to not use as input arguments numbers beyond the range of normal performance for the board.

2.6. Planned Extensions The program will be supplemented by a stand-alone program skytest.

2.7. Limitations The existing test only exercises add, subtract, multiply, divide, sine, and elementary context change operations. For completeness, more tests need to be added, but are deferred until the next version mentioned above.

2.8. Applicable Documents

The System Installation and Maintenance Guide for the Sun Workstation Models 120/170, section 7.10 Sky Floating Point Board

Sky Fast Floating-Point Processor System Integration Manual 800-1104-01

2.9. Definitional Conventions

2.9.1. Notations

2.9.2. Syntax

2.9.3. Terminology

3. REQUIRED TOOLS AND TEST EQUIPMENT

3.1. Equipment List

A) Sun workstation with 1Meg or more of RAM.
B) Facilities to boot UNIX on that workstation.

4. TEST SET-UP

4.1. Test Configuration You will need all in one directory, the files:

ffpusr
sky.ucode

4.2. Rev. Level Check

4.3. Illustrations

5. PRE BURN-IN TEST

6. BURN-IN TEST

Place the printed circuit boards in a burn-in oven for a period of 72hours, at 70C.

7. POST BURN-IN TEST

A) Set the + 5V supply to 4.5V.
B) Boot UNIX, login as root, make sure /dev/sky has been deleted, and then change directory to that containing the sky diagnostic (usually to be found as a part of SysDiag).

host# cd ~sysdiag

or

host# cd /usr/diag/sysdiag

Once the "cd" command is complete, enter the command "ffpusr". Once the diagnostic has loaded, and prompts you with a "?", enter the "a" auto command. Initial register tests are performed, the SKY RAM is tested, and finally the microcode is loaded, the board initialized and then, the "automath" test runs. At completion, enter the "q" command.

Thus:

host login:root

host#rm /dev/sky (This need be executed only once after installation)

host#cd /usr/diag/sysdiag

C) Set the + 5V supply to 5.5V, and initialize and restart the test:

?a

==>automath: testing math

	total samples: nnnn
operation	max number of difference bits
addition	1
subtraction	1
multiplication	1
division	1
sine	5e

?q
root#/etc/fasthalt

8. TEST RESULTS

8.1. Attach Tags

8.2. Log Errors Anything other than the "automath" test beginning message, and the final summary table, will be error messages which indicate board failure. Normally there will me a maximum of 1 bit difference for the add, subtract, multiply, and divide functions, and a maximum of 5e bit difference for sine function. If these limits are exceeded, the program will automatically provide error messages giving details of each failure.

APPENDIX

9. APPENDIX SECTION

INDEX

10. INDEX SECTION

EXTERNAL SPECIFICATION
(User Perspective)

TITLE : Sky diagnostic FFPUSR External Specification

AUTHOR : Sunny Kirsten

REPORT NO. :

REVISION NO. : @(#) sky.txt 1.11 3/21/85

DATE : April 5, 1985

STATUS : Draft

APPROVALS : DATE

Originator: Sunny Kirsten ----------

Test Engineering ----------

Manufacturing ----------

Production ----------

Quality Control ----------

Document Review Form

Please make note and initial on this page all corrections and/or proposed amendments by page number and/or section number.

Recommendations, Differences, Construction Errors, and comments:

Typographical Errors:

Attach additional sheet(s) as needed.

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Purpose The Sky board diagnostic FFPUSR is a component of SYSDIAG, and is used as a UNIX-based board test. It is a quick Go/NoGo test of the Sky board hardware. It is not intended to thoroughly exercise the Sky microcode, but instead focuses on functional testing of sufficient level as to reject an obviously bad piece of hardware.

1.2. Applicable Documents The Sun document 800-1104-01 describes the Sky board, and its installation in a Multibus system, and tells something of the Sky version of FFPUSR, and associated software. This document is not needed to operate the program, though it would be useful if you wanted to decipher hardware bit patterns mentioned in error messages, to isolate problems within the Sky board. Since Sun does not repair these boards in-house, internal fault isolation is not intended.

1.3. Definitional Conventions

1.3.1. Notations FFP is an acronym for Fast Floating Point

1.3.2. Syntax

1.3.3. Terminology

2. SYSTEM OVERVIEW

2.1. General Description The Sky board diagnostic FFPUSR is a Sun customization of the Sky supplied f77 program FFPUSR. The modifications by Sun added code to allow operation in a Go/No-Go environment, where the amount of user interaction was to be minimized, rather than the full manual control offered by the version supplied by Sky.

2.2. Features This program is typically used in board level test by executing the FFPUSR command a (Auto), for automatic test of the basic math functions, and simple context switch operations. The system level test SYSDIAG uses FFPUSR with the commad d (Diagnose) in the devtest section.

2.3. Required Configuration The required configuration is a Sun system with one Sky board. Installation details are contained in the referenced documentation. Note that for Multibus, the connections on JP-01 should be 1-11, and on JP-02 should be 1-3-6 and 4-5. For actual use in a UNIX system, the file /dev/sky must exist. The file /dev/sky must be removed for FFPUSR to operate correctly. If /dev/sky exists, UNIX will believe it has use of the board. When you run FFPUSR, it thinks it has use of the board. If both occur simultaneously, then they will interfere with each other and the result will be a system crash.

2.4. Error Handling Errors are reported in messages directed to stdout. Testing continues.

2.5. General Performance Characteristics The test will typically take on the order of 6 minutes to complete one error-free pass.

2.6. Planned Extensions For board-test usage, ffpusr will be replaced by skytest, a stand-alone program, not requiring UNIX as the current test does.

2.7. Limitations The existing test exercises only single precision add, subtract multiply, divide, and sine math functions, along with a simple "between-operations" context switch. The program allows 1 bit of difference between the answers produced by the Sky board, and those of UNIX' floating point libraries. It further allows 5e bits difference in the sine function. It also contends with the Sky board's handling of underflow towards zero.

3. . SPECIFICATION

3.1. User Interface The user interface is based on menus and simple, one character commands. The program prompts with a "?". If the user replies with a "?", the program will display a command menu. Since this is an extension of the Sky code, it includes all the low-level bit-fiddling commands Sky provided. The main command used by Sun is "a" for automatic testing which will produce error messages for any detected errors, and which produces a performance summary for each math operation, at the end of the test. This command may be used only once per invocation of the program.

3.2. Input/Output Stdin and stdout are used for commands and program responses. The program will expect to find the microcode files in the current directory.

3.3. Operation Login as root, rm /dev/sky, cd to the directory containing FFPUSR. Enter the command "ffpusr", and once the program loads and prompts with a "?", enter the command "a" to start the test. After testing the registers, and then the RAM, the program will load the microcode into the board, and then test math functions, completing with a summary of bit differences between the Sky board and the UNIX floating point library. It is normal to see the entry "1" for all the functions add, subtract, multiply, and divide. Sine, however, may be up to 0x5e. If any of these had been overlimit, there would have been error messages produced previously with full details.

3.4. Error Handling Errors are reported in messages directed to stdout. Testing continues.

3.5. Performance Performance is minimal, but sufficient to reject a truly bad board.

APPENDIX

4. APPENDIX SECTION

valid function codes are:

? = help (display this table)
h = help (display this table)
a = automatic GO/NOGO diagnostics
d = Diagnose for SysDiag
r = register diagnostics
m = memory diagnostics
l = load ascii microcode into ffp
i = initialize the ffp
t = test selected math functions
e = execute a pio sequence
p = pio communication
f = do a spfp ffp function
s = do a special function
b = base address modifier
c = user context swap
q = quit - return to o.s.

INDEX

5. INDEX SECTION