S U N Microsystems

Sun-2 VME-Multibus Adapter Board Diagnostic

User's Document

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Revision A

Contents

1. Preface

This document presents the Sun-2 VME-Multibus Adapter Board Diagnostic.

1.1. Purpose

It is the intention of this document to give the user the knowledge of how to use the diagnostic to test and debug the VME-Multibus Adapter boards.

1.2. Audience

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

Manufacturing and Field Service personnel will use the Sun-2 VME-Multibus Adapter diagnostic for testing and/or trouble shooting purposes. Member(s) of the Diagnostic department will review the design of this diagnostic based on this document. Finally, Documentation will use this document as a basis for developing the User's Guide which will be shipped with the product itself.

The reader of this document assumed to have some knowledge of understanding Sun-2 VME-Multibus Adapter Board, and SCSI board together with a general knowledge of Sun-2/160, and/or Sun-2/50 machines. The user is strongly adviced to review the Engineering Manual for the Sun-2 VME- Multibus Adapter Board and related sources.

2. Revision History

Revision A   06/05/85   Initial release of this document. Revision B   06/27/85
Second release.

3. Glossary

The term *station* and *machine* denotes a Sun-2 50/160 work station.

The term *Tester Board* is used for the Modified Sun SCSI Board.

The term *Program, Diagnostic* means the VME-Multibus Adapter Diagnostic.

4. Introduction

The VME-Multibus Adapter Board Diagnostic is a tool to test the functionality of the VME-Multibus Adapter Board and debug if it is necessary. All functions of the board are tested through the use of the Tester Board. By including easy to use scope tests, the user will be able to locate any problems.

5. Requirements

The VME-Multibus Adapter Diagnostic runs on SUN-2 50/160 machines.

5.1. Hardware Requirements

The following is the list of components required to run the diagnostic:
A test station containing:
- either a Model 50 or 160 Sun Workstation
- a modified SCSI board(tester board)
- a means of booting the diagnostic, and
- a monitor.
The monitor may either be a "*dumb terminal*" or a Sun monitor, video board, and keyboard.

6. General Information

This Diagnostic will not run on sun-2/100/120, or any other Sun Work Station that does not support VME Bus. Before plugging the VME-Multibus adapter and Tester Board, make sure that all switch settings on both boards are correct. Refer to the switch setting sheet at the end of this manual.

6.1. Hardware-Related Information

There are 12 DIP switches on the VME-Multibus Adapter Board. DIP 9, and 10 are not used. Note that if the Interrupt Vector PROM is installed on the board, all the switch sections in DIP 12 must be set to OFF. For a more detailled explanation about switches, please refer to "*Engineering Manual for the Sun-2 VME-Multibus adapter Board*".

6.2. Software-Related Information

The VME-Multibus Adapter Diagnostic is a stand-alone program and will not run under Unix. For accurate result, do a hardware reset(K2) or power off and on before booting the diagnostic.

7. Operating Instructions

Configure your station as explained above and follow the steps in the next section.

7.1. Loading And Starting

```
>K2
>boot stand/vmad.diag
```

For a detailed explanation on boot procedure from different devices, refer to *"Sun Workstation CPU PROM Monitor"* manual.

7.2. User Interface

The VME-Multibus Adapter Diagnostic is user friendly and gives the user ultimate control over the test. It is totally menu driven and the menus are present on the screen from the beginning of the test until the end. It manages the screen efficiently, so that there is no screen roll-over or any messages on the screen that are not relevant at the time. In case of some scope loops, the menu is taken away for user convenience in analyzing the problem. As soon as the user is done with such a scope loop, the screen will be redrawn and the test can be continued.

Throughout the test, the user has the option of using the special control keys to stop or pause the normal process. These special keys will be on the top right hand corner of the screen. The special keys and their actions are:

KEY	ACTION
CONTROL C	abort the current test and go back to menu
CONTROL S	stop looping
CONTROL Q	continue looping
CONTROL X	quit program
CONTROL F	turn on/off help option

If the help option is turned on, the program will print a brief explanation of each test as it is being executed. The "help" option is available in manual and debug mode.

The user interface will inform the user of what is going on at any given time. It tells what mode is active, what test or loop test is being executed, and prints the loop number.

In the case of an error it prints the error message and other useful information such as expected and erroneous conditions.

There are three menus, MODE, TEST, and DEBUG. Each time the user will be asked to choose a selection out of these menus by the phrase " *which one ?*" on the screen. The Mode Menu is:

```
    Mode Menu
0 -- Automatic
1 -- Manual
2 -- Debug
```

If mode 0 (Automatic) is chosen, the test will continue executing all tests in the menu. If the test fails, it prints " *the test failed*" and an error message, then returns back to the Mode Menu for another selection. If the test passed, it prints the " *VME ADAPTER DIAGNOSTIC COMPLETED...NO ERROR*" message and asks the user if she/he wants to run again and the number of times to run. If the user chooses to not run the test again the diagnostic will exit.

If mode 1 (Manual) is selected, the Test Menu will appear on the screen and the user is asked for a test selection. The Test Menu consists of seven tests. After the selection, the program prompts " *enter the number of times to run*". Then the diagnostic starts executing that test and prints the loop number. At the end, a message " *test passed*" or " *test failed*" will be printed if the test was or was not successful.
The Test Menu looks like the following:

```
    Test Menu
0 -- Time Out
1 -- Data Path
2 -- Bus Arbitration
3 -- Interrupt
4 -- Byte DMA
5 -- Word DMA
6 -- All
```

                                                                                    . . .

After a test is done it returns to the same level menu and asks for a selection again. The user can go back to Mode Menu by hitting the RETURN key while the program is prompting " *which one ?*".

If mode 2 (Debug) is selected, the program will print the Debug Menu on the screen and ask for a selection. the Debug Menu consists of seven useful scope loops for debugging the board. The scope tests will run forever and can be stopped by one of the control keys mentioned above. The Debug Menu is given below.

```
    Debug Menu
0 -- Probe Board
1 -- Reset Board
2 -- Interrupt
```

3 -- DMA Write
4 -- DMA Read
5 -- Verify Data Reg
6 -- Verify Count Reg

An example of the screen display when the user has chosen manual mode is shown below:

```
SUN's VME-MULTIBUS ADAPTER Board Diagnostic  Rev 1.1 6/18/85
        Mode Menu              Test Menu            Special Keys:
     0 -- Automatic          0 -- Time Out         ^C abort test
     1 -- Manual             1 -- Data Path        ^S stop  loop
     2 -- Debug              2 -- Bus Arbitration  ^Q continue
                             3 -- Interrupt        ^X quit program
                             4 -- Byte DMA         ^F on/off help
                             5 -- Word DMA
                             6 -- All

                             Which one ?




     YOU ARE RUNNING::
         MANUAL mode:


                                              Help option is off
***************** MESSAGE AREA *********************


                                                          . . .
```

7.2.1. Command Line

The only commands to the program are through the use of control keys which will tell the program to take some action. In fact there is no command line for this program. All inputs to the program are given by answering to the questions that the program asks from the user. If the input from the user is incorrect, a message indicating this fact will be printed and it asks the question again.

7.2.2. Modes

There are three modes available to operate the VME-Multibus Adapter Diagnostic. Automatic, Manual, and Debug modes will give the user the ability of running the test in a mode which is appropriate. The Automatic Mode is a kind of go/nogo test and could be repeated for multiple times. Manual mode can help the user narrow down the problem. And finally, the Debug Mode is used to find the actual problem, of course, a scope is necessary to analyze the problem.

7.2.3. Parameters

All numbers given by the user are handled in decimal. Data patterns for writing into registers while running Debug Mode are treated as hex digits. The patterns can be any size but only 1-4 hex digits are significant.

7.2.4. Tools

The following paragraphs explain in brief the available debug tools provided in this diagnostic.

7.2.4.1. Probe Tool

This debug tool will loop on accesses the data register. The routine will catch bus errors and will not time out. The user can abort this debug loop by entering one of the control keys.

7.2.4.2. Reset Tool

This debug tool will loop on reseting the VME-multibus Adapter Board. Bus errors will not cause the program to abort abnormally. A reset is done by writing a 1 to the reset bit on the control register and the register should read 0x100 after a successful reset. The user can stop the loop by entering one of the control keys.

7.2.4.3. Interrupt Tool

This debug loop will continuously tries to interrupt the board. By lowering the interrupt priority of the CPU, the program makes sure that the interrupt actually happens. It does not check for the interrupt vector number of the current interrupt. This check is done in Interrupt Test in Manual and Automatic mode. This test is only for checking the interrupt lines on the board. The interrupt service routine will do nothing but return to the caller. The user can stop the loop by entering the control key.

7.2.4.4. Byte/Word DMA Tool

This debug tool will continuously transfer the user specified number of bytes/words until user stops the loop with a control key. Each time it will DMA the number of bytes/words and start over and over. The user has the opportunity of checking the read/write DMA strobes and the data/address lines as well. The data is not checked for reliability. This is done in the DMA Test.

7.2.5. Tests

There are six tests present in this diagnostic that could be run while Automatic or Manual mode is active. Each test prints the "TEST PASSED" or "TEST FAILED" message on the screen and returns to the same level menu afterward. Read the brief explanation of each test in the following paragraphs.

7.2.5.1. Time Out Test

This test checks for address lines by writing/reading the data reg. The data is not checked for reliability. Also, it addresses an address that is not in the range of the board to check if time out occurs or not. The bus error handler routine is setup and exchanged with the system's so that the appropriate error message is reported and the program will not abort because of the bus error.

7.2.5.2. Data Path Test

This test is done by writing bit patterns to the data and count registers and reading them back for comparison. All 16 bits are tested for the correctness. In case of error, the error message will be printed and the actual, and expected values will follow.

7.2.5.3. Bus arbitration Test

This test writes bits in control register and reads them back to check to see if right thing happens. It also resets the board and checks the control register to see if it reads as 0x1100. In case of error, the user will be notified and the actual and expected values will also be printed.

7.2.5.4. Interrupt test

This test checks the functionality of the interrupt mechanism and checks whether the correct interrupt vector is addressed or not. In the correct case, the interrupt vector # 72 (0x48) must be addressed. An interrupt service routine is provided for this purpose. If the interrupt does not happen at all or the wrong interrupt vector is being addressed, an error message will indicate this matter.

7.2.5.5. Byte DMA Test

This routine was designed to check the DMA circuitry. First it does DMA in byte mode one byte with one DMA transfer and checks for validity of transferred data. It also checks for correct byte addressing by examining the bytes just before and after the transaction byte. Then if the test was successful, it transfers 256 bytes in one DMA transfer. In case of error, the appropriate error message will appear on the screen and gives the actual and expected values.

7.2.5.6. Word DMA Test

This test will check the DMA circuitry in word mode by writing 256 words of 0's to the CPU memory that has been set to all 1's. All 256 words will be transferred at the same time. Then it will check for values other than 0's. If the test fails, the tool program could be used to try different patterns other than all 0's or all 1's.

7.2.6. Defaults

The following defaults are assumed when the diagnostic starts to run:
    The help option is set off,
    When it is asking for a selection, a RETURN by itself, will pop up the menu,
    All numbers given by the user must be in decimal,
    All patterns given by the user must be in hex.

8. Error Handling

The VME-Multibus Adapter Diagnostic was designed to catch all possible errors that might occur during the test. System bus error and timeout errors also are honored and the appropriate error message will notify the user of errors. The program will stay alive after the error condition and be ready to process other selections. The error messages are self explanatory. All error messages will display the error and the actual and expected values if applicable.

8.1. Error Messages

The following are the list of error messages that will be displayed during the test. In these messages 'T' is the name of the particular test, and 'X' is a hex value.

* bus err occured while testing 'T'

* dma time out occured while testing dma
the DMA count reg read 'X'   should read 'X'
the DMA address reg is 'X'

* reset board failed
the control reg reads 'X'   should read 'X'

* intr signal is not passed to adapter board
the control reg reads 'X'

* wrong intr vector is used
the interrupt vector 'X' must be used, check DIP 12

* data miss compare
wrote 'X' to reg   read back 'X'

* byte packing error occurred during dma transfer
the incorrect byte address was passed by the adapter

8.2. Failure Analysis

The easy to use debug(scope loop) tools give the user the chance to analyze the failure in an efficient way. These tools will loop on the problem forever unless stopped or aborted by the user. The program will continue after the user chooses to abort the scope loop, therefore

eliminating the need to reload the diagnostic after scope loops.

9. Recommended Test Procedure

The recommended test flow is as follows:
 a - Setup the required hardware
 b - Insert VME-Multibus Adapter Board and Tester board in machine
 c - Power on the machine
 d - Boot the VME-Multibuss Adapter Diagnostic
 e - Select Automatic mode
 f - If the test passed go to step k
 g - Select Manual mode and run the failed test several times
 h - Select Debug mode and run the appropriate tool to analyze
  the failure.
 i - Stop the loop and select other scope loops until you find
  the cause of the failure
 j - Go to step l
 k - Run the test 5 times
 l - Abort the program by ^x (CONTROL X)
 m - Power off the machine
 n - Go to step b, if more boards to test.

10. Summary

The VME-Multibus Adapter Diagnostic is a stand-alone, bootable-over the-net-program used for testing and troubleshooting of Sun-2 VME-Multibus Adapter Boards. It runs in all Sun-2 machines utilizing VME bus. The program is user friendly and easy to operate. It is menu driven and manages the screen in an attractive way so that the operator will not get tired of running the test numerous times. It gives the option of controlling the process and provides the user with self explanatory messages. Finally, it tests all aspects of the board for efficient testing.

11. References

MC68000, 16/32-Bit Microprocessor Programmer's Reference Manual, Fourth edition.

Engineering Manual for the Sun-2 VME-Multibus Adapter Board, Revision 50, April 1, 1985.

How to Test VME-Multibus Adapter Board, by Mitch Bradley.

Sun SCSI Programmers' Manual, by Mitch Bradley April 4, 1984.

12. Switch Setting Worksheet

DIP6

1	2	3	4	5	6	7	8
ON	ON	OFF	OFF	OFF	OFF	OFF	OFF

DIP8

1	2	3	4	5	6	7	8
ON	ON	ON	ON	ON	ON	ON	ON

DIP5

1	2	3	4	5	6	7	8
ON	ON	OFF	OFF	OFF	OFF	OFF	OFF

DIP7

1	2	3	4	5	6	7	8
ON	ON	OFF	ON	OFF	ON	ON	ON

DIP2

1	2	3	4	5	6	7	8
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

DIP4

1	2	3	4	5	6	7	8
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

DIP1

1	2	3	4	5	6	7	8
ON	ON	ON	ON	ON	ON	ON	ON

DIP3

1	2	3	4	5	6	7	8
ON	ON	ON	ON	ON	ON	ON	ON

DIP11

1	2	3	4	5	6	7	8
OFF	OFF	OFF	OFF	X	X	X	X

DIP12

1	2	3	4	5	6	7	8
ON	ON	ON	OFF	ON	ON	OFF	ON

The 'X' means don't care. The switch setting mentioned, will set the:
    memory space size to 16k
    memory base address to 0x280000
    No Multibus I/O Space
    20-bit Multibus DMA addressing
    Interrupt Vector to 0x48

Set the three switches on the Tester Board(Modified SCSI) as follow:
    U305   6 ON, all others OFF
    U315   2 ON, all others OFF
    U312   6 ON, all others OFF