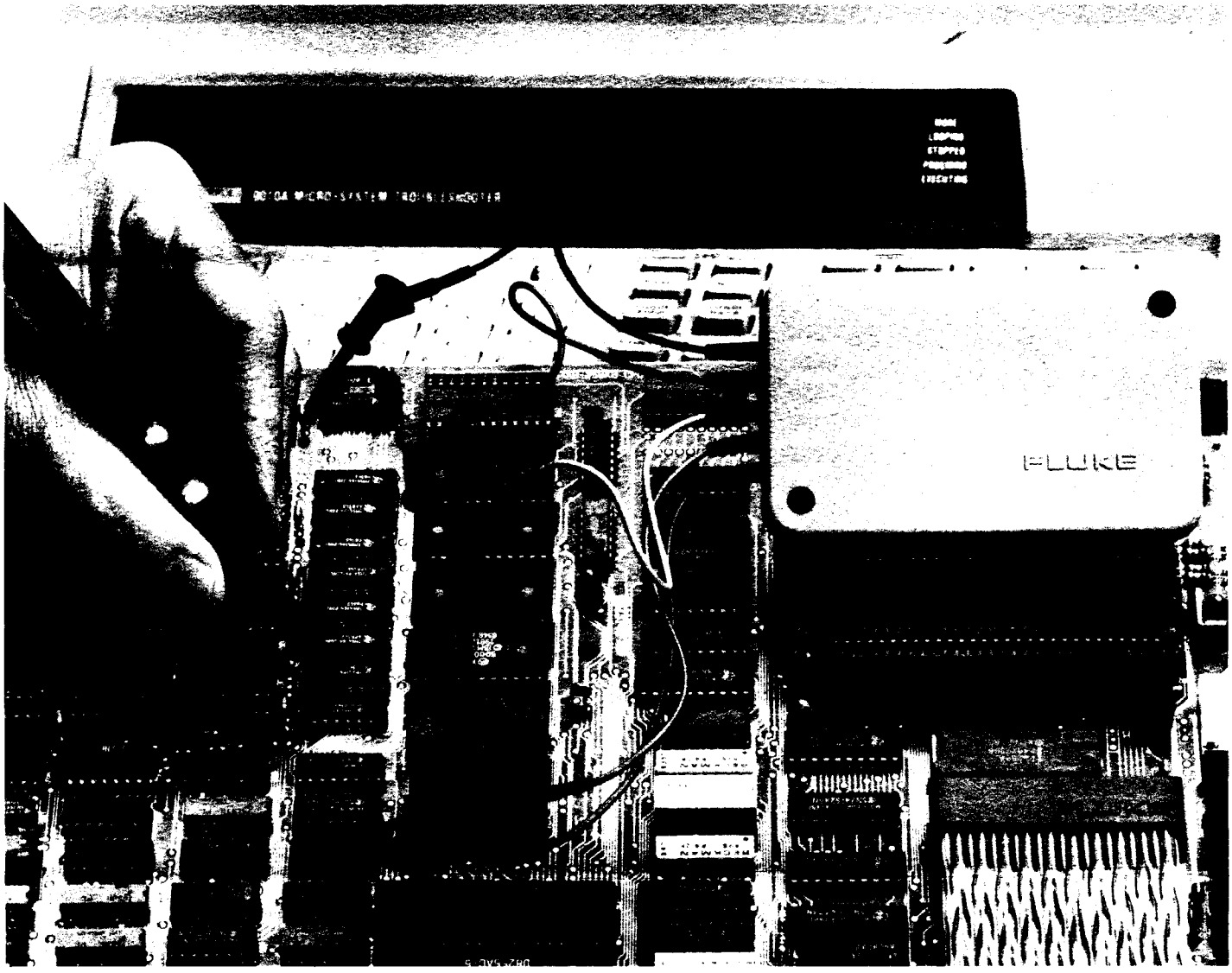
FLUKE
TROUBLESHOOTER
VOL. 3 NO. 3 FOR MICRO-SYSTEM TROUBLESHOOTER USERS



Testing beyond the kernel

by Jim Clodfelter

By adding the new Fluke Asynchronous Signature Probe Option to your 9000 Series mainframe, all your digital troubleshooting needs will be satisfied. The Micro-System Troubleshooter has long been recognized as the easiest and most powerful method of testing bus related problems on a microprocessor-based system. Now, with the addition of the Async option, the Troubleshooter has the expanded capability to not only test circuitry off the kernel, but to test digital boards operating independently of the microprocessor, as well.

With this option, the Micro-System Troubleshooter has the capability:

- to take **signatures** on digital circuits that operate asynchronously from the microprocessor;
- to capture **Wave Forms;**
- and to take **Higher Measurements of Transition Counts.**

Signature Analysis has long been used as a viable method of testing nodes that are on the off-the-bus network. When using a 9000 Series mainframe, the oper-

(continued inside)

TestWriter™ — New software for creating GFI programs

A new software package is available that will reduce your programming time when creating Guided Fault Isolation (GFI) programs. Fluke TestWriter, an IBM compatible software package, can help you create an automated method of isolating faults to the component.

TestWriter works in conjunction with Fluke's 9020A-001 Micro-System Troubleshooter, providing a simple, easy-to-use troubleshooting solution. Once the GFI programs are written an operator easily implements testing from a menu and follows simple instruction from the PC's screen. These directions are backed up through graphic displays indicating the point to be probed and the results of any tests performed on that node.

Creating a GFI program

Creating GFI routines can be a tedious and time-consuming task. The special features built into Test Writer make this process easier and less time consuming than with any other system presently on the market.

The first steps in creating a GFI program with TestWriter are easy and straight forward. First, all the different types of devices used on the UUT are identified and listed along with the input to output relationship of each device. Another part of the file references each UUT reference designator to its proper type. Next, all the connections on the UUT are described so the software can identify which pins are connected together and therefore know how to backtrace the fault. Entering these first three parts does not require the skill of a highly paid programmer or engineer. Someone who can read parts lists and follow the connections on a schematic can enter this information using a simple text editor.

If the format is compatible, the interconnectivity from a CAD/CAM data base can be downloaded into the PC. An editor would be used to make any format corrections so that the data matches TestWriter's requirements.

Next, a programmer enters the stimulus programs in a simple readable form e.g. ramp @ F000, Toggle Address, etc. Once stimulus programs have been written covering all output pins on the UUT, a simple interactive method is used to collect and save the proper responses at each output node on a "KNOWN GOOD" UUT. It is these "KNOWN GOOD" responses that will be used to test a bad UUT.

At this point the software is ready to find faults on a bad UUT. The Troubleshooting tree, or backtracing, is already contained in the software, making the need to generate decision statements unnecessary.

The software's ability to trace down faults by working with the UUT's description file, is what makes generating GFI programs easy and fast. No other product on the market today makes this task as easy.

Using TestWriter

TestWriter is not a GFI program compiler like the 9LC. When using TestWriter for testing and troubleshooting, the Personal Computer (PC) along with the software acts as the controlling element in the test system, sending commands to the 9020A-001 Micro-System Troubleshooter over the RS-232 interface.

The 9020A-001 sends response information back to the PC, where the TestWriter software decides on what to do next in the testing process. Any ERRORS received from the 9020A are automatically handled by the software and appropriately displayed on the PC's CRT.

The operator interface is very simple and easy to use. The interaction is not intimidating and does not make the operator feel like he is a human robot. The operator can work interactively with the software to find the fault or follow the prompts explicitly.

TestWriter works WITH the operator in finding faults by allowing him to take over the operation at any time. Easy to read menu screens are used to allow the operator to select different testing and troubleshooting processes. During the GFI process the operator can redirect the software to any node on the board simply by entering the node's description through

(continued inside)

Beyond the kernel . . .

(continued from cover)

ator uses the probe to measure signatures created as a result of UUT stimuli or of Trouble-shooter-generated stimuli. The clock module of the Async option connects external Start, Stop, Clock, and Enable leads to the UUT. The signals at these leads define the acquisition interval (window) for the signatures gathered by the probe. The operator benefits by being able to isolate faulty nodes on a UUT when the timing is not related to the microprocessor. Video and DMA controllers are two examples of this type of design.

Waveform capture capability takes 32 samples through the probe at a rate of 1 every 20 nanoseconds. These samples can be viewed on the mainframe's display and indicates the condition of each sample (high, low or tristate). This feature allows the user to measure setup times, the dynamic RAM waveforms and other types of timing.

Higher measurement of transition counts allows the operator to record up to sixteen million transition counts with the probe. The operator can start and stop the count either through a program (software gated) or through external signals (externally gated). With this feature the user can verify the operations of counters, timers, DMA transfers, etc.

The software to run these routines on a 9005A or 9010A is provided on a cassette tape. After loading the cassette tape and executing the initialization routine, the operator attaches the clock module leads to the appropriate test points. The desired triggering signals are then selected by the operator. To measure signatures, capture waveforms, or record counts, the operator merely presses the Read Probe key on the mainframe and the display will show the results. Each additional measurement can be taken by again simply pressing the Read Probe key. To utilize this option on a 9020A, appropriate code must be generated from your system controller.

The features of the Asynchronous Signature Probe option can also be individually incorporated into troubleshooting programs generated by each operator. The cassette tape contains many subroutines that can be selected and used as needed by the operator. A good example of this would be if an operator only wanted to measure counts. A special merge tape program is included on the cassette that allows the operator to select specified programs and merge them with existing programs.

If this option is purchased at the time you order your mainframe, there will be no installation charge. If you wish to upgrade your existing mainframe, you must order the option by March 31, 1986, to receive free installation. Any orders received after that date for upgrading systems in the field will be charged an installation fee.

Mainframes containing internal software version 2C or newer can be directly upgraded. With software versions 2A or 2B, you will need to upgrade your software if you wish to add the Async Probe option. Mainframes with software version 1A can not be upgraded to use this option.

For more information on the Asynchronous Signature Probe option, or a demonstration of any Fluke 9000 Micro-System Troubleshooter, contact your local sales representative.

Get a free Fluke 77 Multimeter

In every issue of the TROUBLESHOOTER we include an article offering a free Fluke 77 Multimeter—and this issue we are once again repeating the offer. How can you get one? Write an article for the TROUBLESHOOTER and have it published.

The TROUBLESHOOTER is looking for customer-written articles that cover solutions to difficult testing problems, and unique Troubleshooter applications. Articles should be submitted to:

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Everett, WA 98206

Published articles will carry your byline and your company's name. Plus, a Fluke 77 is yours when your story is published.

9010A Advanced Training

As of October 1, 1985 the 9010A Advanced Training Seminars will be conducted by our Customer Support Services (CSS) on a regional basis. Since each region (East, West, & Central) will have their own instructor and training equipment, more seminars will be available to our users. In the past we had been doing a seminar in each of our 14 districts about once every 8 months. Now we will be doing seminars in more areas more often than ever before. To register for the seminar most convenient for you, contact Fluke Customer Training at (800) 843-2773.

U.S.

LOCATION	DATE
1986	
Knoxville, TN	Jan 7–8
Los Angeles, CA	Jan 7–8
Dallas, TX	Jan 14–15
New Orleans, LA	Jan 21–22
Santa Clara, CA	Jan 21–22
Tampa, FL	Feb 4–5
Phoenix, AZ	Feb 4–5
Rolling Meadows, IL	Feb 11–12
Miami, FL	Feb 18–19
Ft. Lauderdale, FL	Mar 4–5
Kansas City, MO	Mar 4–5
St. Louis, MO	Mar 11–12
Orlando, FL	Mar 18–19
Austin, TX	Mar 25–26
Atlanta, GA	Apr 1–2
Minneapolis, MN	Apr 1–2
Charlotte, NC	Apr 15–16
Raleigh, NC	Apr 29–30
Rolling Meadows, IL	May 13–14
Rockville, MD	May 20–21
Wichita, KS	May 27–28
Baltimore, MD	Jun 3–4
Paramus, NJ	Jun 17–18
Detroit, MI	Jun 24–25
Boston, MA	Jul 8–9
Rolling Meadows, IL	Jul 22–23
Minneapolis, MN	Aug 5–6
St. Louis, MO	Aug 19–20
Nashua, NH	Sep 2–3
Syracuse, NY	Sep 16–17
Seattle, WA	Sep 23–24
Rolling Meadows, IL	Sep 29–30
Los Angeles, CA	Oct 7–8
Santa Clara, CA	Oct 21–22
Phoenix, AZ	Nov 4–5
Dallas, TX	Nov 18–19
Rolling Meadows, IL	Dec 16–17

(continued)

TestWriter . . .
(continued)

the keyboard.

This means that TestWriter will allow an operator to use his own thought process in tracing down the fault. If he is unsuccessful he can then revert back to total TestWriter control.

As the software tests the UUT, the operator gets a graphical representation of how the tests are progressing. Each tested node is displayed graphically on the PC's display indicating the results of each test. In this way the operator can feel confident in using the GFI process.

If the operator should mis-probe a node, it will be readily apparent to him from the information in the display. Re-testing a node is accomplished by one simple stroke of a key on the keyboard. The new test information over-writes the old erroneous responses and GFI can continue.

TestWriter is compatible with the new Asynchronous Probe Option also mentioned in this issue. The responses from the asynchronous option are graphically displayed on the PC giving the operator very positive feedback on his tests.

Additional Features

While writing your GFI program, TestWriter has a programming tool called TWLIST that can tell you what your fault coverage is, as a percentage of all identified nodes, as well as show you specifically which nodes are and are not tested by your program. Additionally TWLIST shows which stimulus programs and the proper responses are used for each output node of your UUT. This tool helps a programmer complete the GFI writing process and reach full node coverage on his UUT.

During the GFI process TestWriter keeps a list of GOOD and BAD nodes so that the operator can review them and decide if he can help TestWriter find the faulty node quicker. If the operator recognizes the problem from this list he can type in a node that is closer to the suspected problem and speed up the GFI process.

In Summary

TestWriter is an easy-to-use software package for test engineers and service technicians who desire Guided Fault Isolation on their UUT's. It reduces the amount of time to create such a program and makes it easy for an operator to follow. There are a number of features in this package, some of which space does not allow us to cover here, that appeal to both the programmer and the operator. If you feel TestWriter may be an answer to your needs then contact your nearest Fluke representative for additional information.

Taking measurements with the Async option in a programming mode

The new Asynchronous Signature Probe Option from Fluke comes complete with all the software to operate the option in the immediate mode. But the operator has the added capability to customize their own routines using the programs provided with the Async option as subroutines for a larger customer designed testing package.

The cassette tape provided with the Async option contains the Merge tape program (Program 0 Side B) that allows the operator to selectively pull programs from a master tape and merge them with new programs under development. Using this program the operator can select those programs from the Async option software that will best fit their needs for testing.

Several programs are supplied on the cassette included with the Asynchronous Signature Probe Option. Below is a listing of all the programs; an explanation of each program can be found in section three of the operators manual.

Program Number	Program Name
Side A	
0	Initialize
1	Interactive Operation
2	Service Gate Keys
3	Service Setup Key
4	Display Gate
5	Start Setup
6	Stop Setup
7	Clock Setup
8	Enable Setup
9	Stop Count Setup
11	Event Setup
12	Setup Hardware
13	Arm Gate
14	Get Signature
15	Get Events
16	Get Waveform
17	Read Data and Status
18	Send Op Code
19	Display Waveform
20	Append Signature

Programs 0-9 and program 11 are user interface programs used by the option when it is operating in the interactive mode. Their primary function is to load the initialization register (Reg 8) with the proper setup values for the polarity of the control signals, source of the control signals, count limit for the stop counter, and mode of the events counter.

Programs 12-20 are library programs used by the option, independently of one another and the user interface programs. These programs will become a part of the troubleshooting sequence when gathering signatures, event counts or waveforms.

1. Initialize Register 8

The first step in incorporating the Asynchronous Signature Probe Option into a guided troubleshooting routine is to load the initialization register. If the programmer knows which setup values he wants they can be loaded into the initialization register by using the bit assignment as documented in Table 3-3 of the operators manual. Bits 3 thru 29 of register 8 are used for initializing the setup commands.

Another way to determine the desired value in the initialization register is to Execute Program 0 of the operating programs provided with the Async Option. Then enter the Set-up mode and manually set the desired values for START, STOP, CLOCK, etc. After all the set-up values have been entered, stop Program 0 and look at the contents of Register 8. It will contain the intialization value that represents the setup values you just selected.

2. Execute 12

The operator then sets up the hardware of the module, based on the value in the initialization register, by executing Program 12.

3. Execute 13

Next, Program 13 is executed, which arms the gate, preparing the module for actually taking signatures. This program resets all the registers within the module and then arms it to receive control signals (START, STOP, and CLOCK).

The first three steps, initializing Reg 8, Executing Program 12, and Executing Program 13 will be standard for any programmming done with the Asynchronous Signature Probe Option. The steps that follow will depend on the type of stimulus used and the desired parameters that are to be measured.

4. Stimulate Circuit

The next step is to provide some stimulus to the circuit. This can be in the form of a subroutine generated from the 9000A mainframe such as the WALK or RAMP function. Or the operator can write

(coninued next page)

Async measurements . . .
(continued)

a program to provide the stimulus to the circuit under test. If the program uses an operator generated stimulus then the program can proceed to Step 5 because we know the stimulus has been completed.

However, if a UUT generated stimulus, such as the refresh signals in a DMA circuit, is used then the program must wait until the specified measurement window (as determined by the set ups) has occurred. This can be accomplished by using Program 17 which gets Data and Status information. This program loads status bits into register B that indicates when certain events have occurred. Bits 4, 5, and 6 indicated the occurrence of a CLOCK, START, and STOP respectfully. A loop should be written into the program following Program 13 that monitors the status, looking for the CLOCK, START, and STOP as determined by the setup commands. Following the execution of Program 17, when register B contains a 70 (bits 4, 5, and 6 set high) the stimulus is complete.

5. Execute 14

Following the stimulus you would execute the program that retrieves the particular piece of data you are interested in. To obtain the signature, Execute program 14, which places the signature data in register B. Your testing program can now compare the measured signature with the actual expected value or display the measured value to the operator for analysis.

6. Execute 15

To look at the event count, execute program 15, which stores the event count in register A. One stipulation is that program 14 must be executed before program 15 is run. Signature data must be shifted out of the register before the event count is placed in a position to be retrieved.

7. Execute 16

Program 16 places waveform information into registers A and B. Register A will have a bit set high whenever a high is measured and Register B will set a bit high when ever a low is measured. If a common bit is low in both registers, that indicates a tristate condition at that moment in time. This program must be run after programs 14 and 15 to insure that signature and event count data has been shifted out of the register. This program also overrides the data placed in registers A and B in the previous programs so that when you execute 16, you no longer have access to signature and event count information.

8. Execute 19

With the proper levels stored in registers A and B, you would then execute program 19 to display the waveform to the operator.

Another example of using the waveform capture would be to see what level was present at a particular instant in time.

Each bit in register A or B represents a 20 nanosecond window in the data path. If you wish to see what level was present 180 nanoseconds prior to your reference or STOP signal you would look at bit 9 in the register. Suppose the correct or expected value was a logic high occurring 180 nanoseconds prior to your STOP signal. To test for its presence you would execute the following step after executing program 16: If Reg A and 100 > 0 then a high occurred 180 nanoseconds before the STOP signal.

The following is an example of a typical application of the Async Option in a Guided Fault Isolation type program testing DMA circuitry.

This program can be easily modified to fit your particular needs, whether you want to measure signatures, counts, or waveform information. Operator induced stimulus, such as programmed subroutines can be inserted prior to Label 1 and all the programming steps between Label 1 and Label 2 could then be eliminated.

The power of the Fluke 9000 Series Micro-System Troubleshooter has always been in its flexibility. The new Asynchronous Signature Probe Option, 9000A-006, adds to that flexibility and makes the Troubleshooter the most powerful testing tool available. For more information or a demonstration call your local Fluke sales office.

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Execute Program 0                    Obtain the initialization values for reg. 8.

PROGRAM 90

Dpy-"Place Probe on U17 pin 22"      Prompts the operator to go to a specific test
                                     point.
Stop                                 Wait for operator to place probe and then
                                     press Continue
Reg 8 = 528                          Set initialization values

Exec 12                              Set up hardware according to values in ini-
                                     tialization register
Exec 13                              Arm Gate

Label 1

Exec 17                              Read Data and Status

If Reg B AND 70 = 70 goto 2          Check to see if CLOCK, START, and STOP
                                     have occured
GOTO 1                               If not return to Label 1 and check again

Label 2                              Stimulus has occurred at this point

Exec 14                              Get signature

Reg 1 = AF6C                         Set expected signature for test point U17 pin
                                     22
If Reg B = Reg 1 GOTO 4              Signature is good, go to next test point at
                                     Label 4
Goto 3                               Signature is bad, go to next test point at
                                     Label 3
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.
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9010A Advanced Training
(continued)

EUROPE

WEEK	COUNTRY	LANGUAGE
3/4	UK	English
4/5/6	Germany	German
8	France	French
9	Finland	Finnish
14	Italy	Italian
15	Benelux	Dutch/ English
15/16/17	Germany	German
18/19	UK	English
22	Finland	Finnish
23	France	French
24	Sweden	Swedish
28/29	UK	English
32	Benelux	Dutch/ English
39	Italy	Italian

Please contact your local Fluke Representative for more information.

9010A Application Support

The following individuals and organizations have indicated their capabilities of, and interest in, providing independent 9010A support. The services offered are shown with each name.

If you would like your name added to the list, please let us know.

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Printed in U.S.A. P0001J-01U8511/SE EN