Technical Data

Fluke 900

Dynamic Troubleshooter

FLUKE

The automated troubleshooter for dynamically testing IC's at speed, while still in circuit

- Tests digital ICs, at speed, while still in circuit
- Detects static, dynamic & intermittent faults.
- Supports standard and custom devices.
- Requires little or no programming.
- Provides clear pass/fail results.

Fixing today's complex digital boards can be a real challenge. Fluke answers that challenge with the 900 Dynamic Troubleshooter. It's a powerful diagnostic tool for servicing your digital boards. The 900 uses a dynamic reference comparison technique to isolate faults down to the individual component: ICs are tested while operating at speed, still in circuit. But unlike in-circuit testers, the 900 does **not** force any artificial signals into the UUT by back-driving devices or guard points. Yet it tests each IC to effectively capture static and dynamic faults. And it requires no programming to get started.

The Fluke 900 tests standard and custom ICs, from SSI to VLSI.. including ROMs, DRAMS, and EPROMs. It will even test custom PALS and ASICs. Components can be tested both in-circuit and out of circuit; a known good IC serves as the reference for each test. This eliminates the need for general test software, and even for device timing models.

The 900 automatically analyzes the performance of the device under test, which can be operating at data rates of up to 20 MHz. Ten nanosecond timing resolution, over a full 20 - 200 nanosecond range, ensures the 900's precision in fault capturing. Input signals for the device under test can also be checked with the 900.

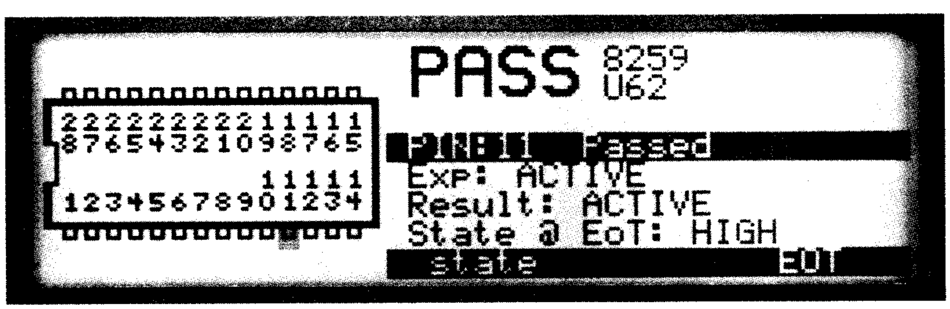
Since it doesn't require any complicated set-ups or interpretation of results, you can begin using the 900 right away.

The Fluke 900 isolates thefunctional board **failure** *to the* **failing** *component. It captures dynamic and intermittent malfunctions as well as static component failures.*

It helps you isolate faults rapidly and accurately. And the 900 is effective as a stand-alone tool, or as a complement to an emulative tester or hot mockup.

An emulative tester, such as the Fluke 9010A, 91OOA, or 90 Series, will quickly test the kernel of your UUT, and localize the fault to a subsection of the circuitry. The 900 is then used to isolate faults down to the defective component. Any of our emulative testers can also be used to generate the required logic activity on the UUT while the 900 tests each component.

The interface buffer is connected to the **main-frame via** *a four-foot ribbon cable.* A full *set of clips is available to accommodate DIP style as well as surface mount small-outline-style digital components.*



Test results are displayed in *easy-to-interpret* for-*mats. Test conditions for each* **pin** *of the device under test may be reviewed in detail.*

Power to solve the tough problems

Proprietary technology has been combined with practical features to give the 900 some unique capabilities. Among these are:

Functional test quality-with in-circuit test resolution

Because each component is tested while operating in circuit, the 900 can detect a wide variety of faults:

Timing-Related Faults. The 900 identifies a failure when the response of the device under test (DUT) differs from that of the reference part. The timing tolerance on this comparison can be adjusted to compensate for normal circuit loading conditions which might affect the response of the DUT; it's adjustable with 10 nanosecond resolution, across the full 20-200 nanosecond range. And fault capture resolution is independent of the signal speed on the DUT, effective from DC to 20 MHz. Logic voltage levels can also be set by the user.

Static Device Faults. The 900 detects logic faults, whether due to blown outputs or internal chip failures. The real-time comparison test ensures that failures are detected immediately.

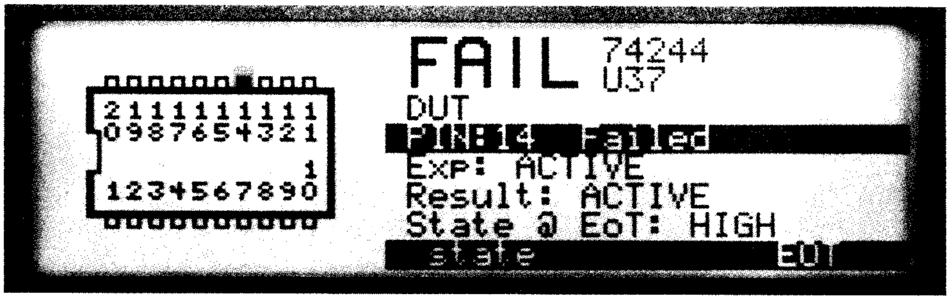
Intermittent and Thermal Faults. The 900 can continuously test the DUT while the circuit board is thermally cycled. Every pin on the DUT is monitored asynchronously, without clocking or sampling. Intermittent or transient faults are thus captured with the same 10 nsec resolution as timing and static faults.

Short circuits and open circuits. The 900 monitors every pin on the DUT for logic status, logic activity, or an expected frequency. It flags any pin when there is no activity -whether due to a shorted node or an open lead. (The actual physical location of a short can then be found with a conventional shorts finder.) The 900 can also be set to ignore a failing pin, so the performance of the rest of the DUT can be verified.

Isolates faults in "untestable" circuits

Some testers have difficulty with components in "untestable" circuits, such as ICs with internal memory that cannot be reset. The 900 readily handles many such common testing problems.

Feedback Loops. Fault isolation in feedback loops can be difficult, since the fault seems to be everywhere at the same time. But the 900 verifies the operation of a chip in a loop, by using whatever inputs are present. Thus, working chips



Upon detection of a mismatch between the outputs of the Reference Device and the cone-sponding output pins of the device under test, the tester ends the comparison and displays the failing output pin(s).

that simply have garbled inputs will pass, but defective chips will be caught. The 900 also measures the amount of time elapsed until a fault occurs. This can be used to identify the first chip to fail in cases of apparent multiple faults.

Bus Devices. Testing bus devices with conventional tools is difficult, because any device connected to the bus can generate activity. The 900 readily tests bus devices, since it automatically gates its testing with the Output Enable signal at the DUT The 29-channel Gate function can be used to further ensure that testing is performed only when the DUT, itself, is active on the bus.

Components with Internal Memory. The 900 tests devices with internal memory, such as latches and counters. It has built-in automatic synchronization routines to put the reference device and the DUT in the same state before the test begins-even when the DUT's internal memory cannot be initialized because control pins are strapped in an inactive state.

Hardwired Inputs & Outputs. The 900 tests ICs when input leads are tied together, or strapped to supply. The reference device and the DUT will see the same data on their respective input pins, and the 900 accepts that as a normal circuit condition. AND/OR gates with hard- wired outputs are handled by using the gate function to enable testing only when the DUT should have control of these nodes.

Memory Testing. The 900 tests memory devices, even DRAM, like any other logic device, since all DUT data and timing signals are replicated on the reference device. The memory locations in both chips are written before testing, so they will have the same data.

Test sequences, not test software

Because the 900 takes advantage of the replacement parts you already have on hand, there's no need to write device timing descriptions or comprehensive test programs. But you do have the option of developing test sequences for your workload. A test sequence lists the order in which to test ICs on a particular board, along with any adjustments to the 900's default test parameters.

Developing a test sequence is simple: it requires checking each IC on a good board to determine whether or not the default test parameters need adjustment. The test parameters are stored along with any prompts for the operator, as part of each step in the sequence. Test sequences can be saved in nonvolatile memory cartridges, or uploaded to a PC over the RS-232C interface.

Any user can run a sequence, stepping through the test for each IC, in order. Experienced technicians are still free to use their intuition. They can jump around in the sequence and readily test any IC on the board.

Tests even when you have no documentation

Incomplete or even incorrect documentation is a real problem with today's constantly changing designs. The 900 provides a solution at both the device level and the board level:

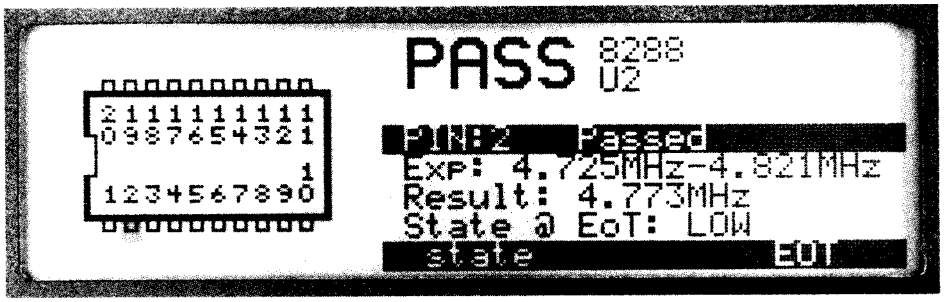
Detailed part descriptions are not necessary, since your known-good IC s define the test for each component-even private-labeled and custom parts. The "identify" mode will also quickly reveal if privately-labeled devices are logically equivalent to common commercial parts.

Similarly, detailed board documentation is not necessary to test an IC on the UUT. However, when developing a test sequence, a board schematic showing device interconnections may be helpful. Subsequent changes to firmware on the UUT will have little or no effect on sequences, once written.

Still more power-extended capabilities

The Fluke 900 has several other features which make it an even more effective troubleshooting tool:

Built-in frequency counter. The 900 can measure signal activity on all of the DUT pins, plus one additional node-at up to 25 MHz, accurate to within 0.5 % . Duty cycle is also measured to characterize clocks and other signals at the UUT.



This results screen indicates *that thefrequency expected at pin* 2 of *this bus controller chip falls well within thespecified tolerances.*

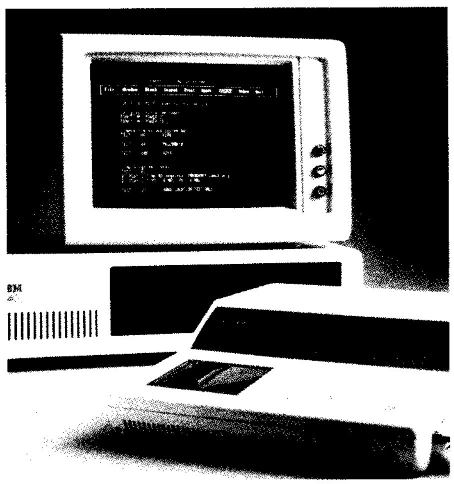
User-definable trigger. A two-word trigger function can be defined from a combination of signals on the DUT's 28 leads plus an external node, to start a test (similar to a conventional logic analyzer). Trigger event detection can be used to start the comparison test, or as a powerful diagnostic tool for finding complex data patterns.

User-definable gate. A one-word gate function can be defined from a combination of the DUT's 28 pins plus an external node. This can be used to mask out indeterminant board conditions, such as bus contention. It can also be used with the frequency counter to measure complex functions, such as the duty cycle and frequency of accesses to memory.

User-definable test cycle. The 900 will issue an automatic RESET signal to the UUT at the start of the test for each device. The user can specify the polarity, duration, and timing, relative to the comparison test. The duration of the synchronization, initialization, and comparison phases can also be specified by the user. This ensures that the 900 is applicable to the widest variety of devices and circuit configurations.

Nonvolatile RAM cartridges. Removable memory modules will hold predefined Test Sequences and test results. You can store modifiable source versions, and write-protected execute-only versions of sequences. These memory cartridges can also be used to distribute Test Sequences to remote service sites.

RS-232C interface. This supports both software and hardware handshake protocols; data rates are programmable, up to 19,200 baud. Test Sequences can be downloaded and test results can be uploaded to your PC. An optional IEEE-488 interface is also available.



The 900 provides the ability to exchange files with a (personal) computer via its *standard RS-232C port. A Test Sequence may be uploaded to facilitate editing and to add operator instructions as well as comments.*

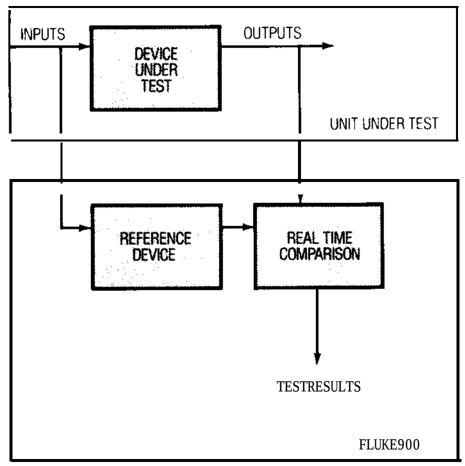
Automatic logging of test results. The 900 can automatically save test results, including a record of each step in the diagnostic process. You can use a memory cartridge, or a device connected to one of the remote interfaces. This is useful for subsequent analysis of failures, and refinement of Test Sequences.

Friendly operator interface. The 900 has a soft-key based menu-driven interface. This supports complete operation of the unit, plus creation and editing of test sequences. The built-in clock and calendar can be used to date stamp test results.

Principles of operation

Dynamic comparison tests

The Fluke 900 operates on the principle of Dynamic Hardware Reference Comparison. This means that the real-*time* operation of the DUT is compared to that of a known good Reference Device (RD) , which is inserted in a zero-insertion-force socket on the tester. The 900 continuously monitors every pin on the DUT, asynchronously, without clocking or sampling.



The known good reference device in the tester is subjected to the same input signals as those observed at the inputs of *the device under test; the output signals generated by both devices are compared in real time.*

The 900 determines which pins are inputs and which are outputs, at any given moment; tri-state and bidirectional pins are handled automatically. It is thus able to apply the same signals that are on the input leads of the DUT to the inputs of the RD. Simultaneously, the 900 compares the outputs of these two chips, and flags any differences as an error. Comparisons are made while the DUT is operating at speed, for data rates of up to 20 MHz. Timing resolution on this comparison is 10 nsecs, over a 20 200 nsec range.

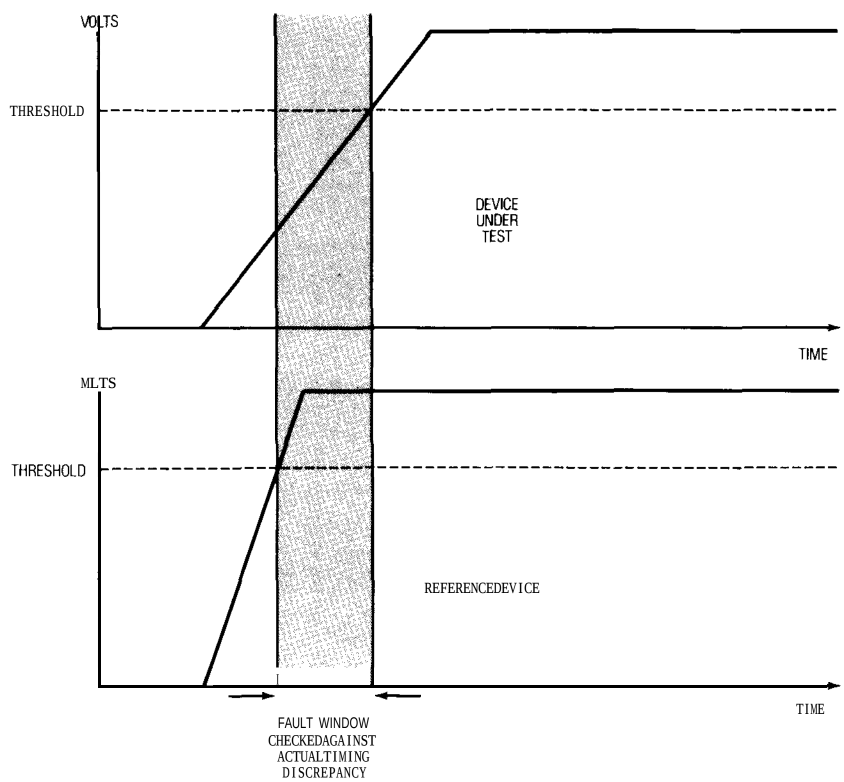
Some logic activity is necessary on the UUT in order for the 900 to test each **IC**. The 900's reset function can be used with a UUT's built-in self test routine to force a few machine cycles of activity under the control of the tester. A hot mockup can also be used to sustain activity on subassemblies which do not function standing alone. Alternatively, an emulative tester, such as the Fluke 9010A, 9100A, or 90 Series, can be used to stimulate activity on the UUT. An emulative tester is also effective at first localizing the fault to a subsection of the UUT, especially when the UUT locks up with a kernel fault.

In general, an RD will not experience the exact same loading as the DUT does in - circuit. This typically results is slight differences in the response times of the RD and the DUT. The 900 accommodates this by using a specifiable value for the allowable difference (a "fault window") in response times for the two chips-adjustable from 20 nsec to 200 nsec, in 10 nsec steps.

Logic threshold levels can also be specified, at any level between 0 and 5 volts, with 100 mV resolution.

The fault window and logic threshold voltage levels together define a Perfomnance ***Envelope*** against which the DUT is compared to the RD.

To determine the Performance Envelope for various DUTs, a known good board should first be checked. Any ICs on this good board which require adjustments in the default test parameters should be noted. Usually less than 10 % of the DUTs will require any adjustments to the 900's default test parameters. These adjustments can be saved in the corresponding step of a test sequence for the UUT.

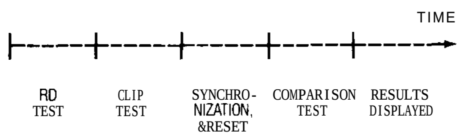


The timing discrepancy between the output responses of the Reference Device (RD), operating** in **ideal conditions, and the Device Under Test (DUT) is masked using a window, called the F-Mask. The output of the DUT is expected to compare with the output of the RD at the** end **of this mask.

Testing, the complete cycle

The test for an IC includes the following steps:

(1) the RD is tested -using predefined test patterns built into the 900, or optional user-specified test patterns;
(2) the DUT clip is checked to verify that it is properly connected;
(3) a RESET pulse is issued to the UUT, at some point during the synchronization interval;
(4) the comparison test is performed;
(5) test results are displayed.



This diagram depicts the sequence of events when the TEST button is pressed on the 900.

Each phase in the test cycle can be extended or skipped, as desired. The synchronization interval works with the reset pulse to initialize the DUT and RD to the same state before the comparison test phase. Timing of the reset pulse, relative to the synchronization process, is predefined for devices already in the 900's device library. This timing is also user selectable.

For sequential devices, such as latches and counters, the synchronization period occurs prior to Reset. It involves stimulating the RD with a variety of logic patterns to bring the DUT and RD to the same state. Once the two devices are in synch, the comparison test proceeds. (A message is displayed if the 900 is unable to synchronize the two devices.)

For devices with hidden states, such as shift registers and programmable controllers, the synchronization interval is extended beyond the reset pulse, to allow for the DUT to be initialized before the actual comparison test proceeds.

As noted earlier, the trigger function also can be used to control the start of the comparison test. And the gate function can be used to selectively control when the comparisons are actually made.

Frequently asked questions about the Fluke 900 Dynamic Troubleshooter:

Test method

1. Is the Fluke 900 similar to other clip-on testers?

Any similarity ends at the clip. The 900 is a dynamic analyzer that monitors normal board activity at real time speeds. The 900 verifies the function of the DUT with that of a Reference Device. It does not force any signals onto the board, nor backdrive devices or guard points. Such techniques are commonly used by IC clip-on in-circuit testers, regardless of their price.

A related class of clip-on IC testers simply checks the analog impedance of each device lead on an unpowered board. Some inexpensive chip comparators are even limited to smaller ICS and simple circuit configurations. They lack programmability for in-circuit conditions and cannot accommodate complex synchronization requirements.

2. Does the board under test have to be powered and operating?

The board must be in the operating environment of a go/no-go test, or some other repeatable routine. This might be the normal board setting, for example in a photocopier or in a hot mockup. A single-board system might require only power andlor being driven by another functional tester, such as a Fluke 9010A, 9100A, or 90 Series. A good rule is to apply the Fluke 900 in the same situations that you'd use an oscilloscope or logic analyzer for manual troubleshooting.

3. What fixturing is required?

Standard IC clips are supplied with the 900. Several other sizes are available as accessories. (Extender cards or cables may be necessary to gain access to some components. Your present-day fixture may be necessary if it is normally used to stimulate the UUT.)

4. Must the clip be moved and the RD changed for every IC test?

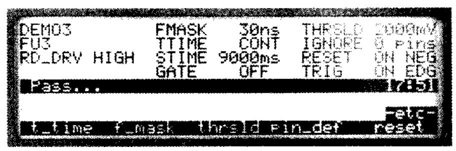
The strength of the 900 comes from its direct visibility to each device under test. Moving the clip is essential to this. Larger clips may, however, be used on smaller devices, since unused clip pins are ignored. This minimizes changing IC clips. Also, you can plan your testing order to minimize changing the Reference Device (RD), For example, testing a bank of RAMS requires no RD changes. Your optimal testing order would be incorporated in a test sequence written for the UUT.

5. Do I have to have a set of known good devices?

Yes. Of course, a supply of good ICs will already be on hand, to repair the board. You can keep the ICs safely organized in the antistatic trays we supply.

6. How do I know that the RDs are good?

Every time the TEST button is pressed, a truth table test pattern is applied to check the RD in the ZIF socket. Test patterns for over 300 devices are built into the 900; you can add test patterns for your custom parts. Any RD may also be checked at speed, by clipping onto a good board to compare against the device in the ZIF socket (a reverse comparison).



This disvlau shows the test varameters to test a complex device like a PAL. Only two parameters need to be modified** from **the "default"settings: (1) the trigger condition (TRIG), and (2) the synchronization time parameter STIME. Parameters can be modified using the soft-labeled function keys.

7. Can the RD and board activity be stored on a cartridge so we don't need RD hardware?

This is undesirable because most stored-pattern testers operate in the kilohertz range of speed. By using actual hardware RDs, the 900 achieves full 20 MHz operation.

Specifications

8. Are surface mounted devices testable?

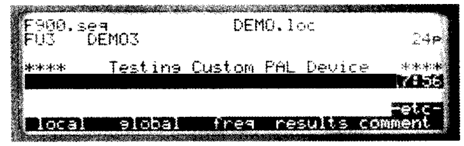
Yes. We offer clips for J-lead SO version devices that have dual sided narrowly spaced pins. The equivalent DIP version IC is used as the Reference Device.

9. Does clipping onto the DUT affect its performance?

The loading per pin is 10 KΩ and 30 pf. This normally does not affect TTL or CMOS devices. Direct clipping on a crystal oscillator will adversely affect its signal.

10. **How** do I test boards that operate faster than the Fluke 996 20 MHz specification?

Most high speed clocks are immediately divided down to lower frequencies for routing around a board. A device counting down the high frequency will have outputs that are half this value, or less; they can be measured with the 900's built-in frequency counter.



Dusing the execution of a Te.st Sequence called F900, the tester is testing a PAL with reference designation FU3. The 900 tests PALS and other custom and semi-custom components without requiring knowledge about the internal programming of these types of devices.

II. What types of devices can I test on a board?

The 900 tests devices with digital inputs and outputs, up to 28 pins with 5V Vcc. For devices with larger pin counts, various signal condition tests provide indirect verification of their operation. These tests include high, low, and active status, frequency measurement, and event detection (two-word trigger on any combination of DUT pin states plus one external node).

12. How many devices are in the built-in device library?

Approximately 350 device numbers and their standard comparison test parameters are stored in the 900. These include 7400 series TTL, most RAM and PROM families, plus many microprocessor support devices of 28 pins or less. You can easily add devices, such as PALS, to this reference library.

Troubleshooting

13. Can the 900 troubleshoot various microprocessor architectures such as the 8085, 68000 or multiprocessor boards?

Yes, this comparison test technique is applicable to virtually any architecture. The 900 looks at each device independently; signals from each pin on the DUT are monitored asynchronously, without clocking or sampling.

14. How do I handle devices over 28 pins?

Use the Fluke 900 to evaluate up to 28-pin devices and determine where the fault is not. Larger devices can be indirectly evaluated with the 900's condition tests, as noted in the answer to question 11. Larger chips which are in sockets or on the microprocessor bus can usually be tested with another approach, such as using the Fluke 9010A or 90 Series.

15. Can the 900 detect differences between S, LS and HC type parts? Can it distinguish between different manufacturers?

Sometimes, under an in-circuit load. The comparison resolution of the timing fault window is 10 nsec. This can be too coarse to detect the slight differences in propagation delay of some logic families. In practice, the 900 can detect the difference when a device is driving a suitable load, since the varying drive capability yields a timing difference of greater than 10 nsec.

16. Does the 900 test line drivers (for example, 1488, 75xxx), or one shots (555,74I23)?

Indirect testing for signal conditions is possible, but not comparison tests. The ZIF socket can only supply 5V to an RD; line driver ICs require ±12V. One-shots have a ramp input from a capacitor, and are thus not strictly digital.

17. Is the DUT fully tested?

The DUT is tested performing the same function it performs in the circuit under normal operating conditions. (Thus if a NAND gate is being used as an inverter, that is how it will be tested.) The rational is that if a UUT is failing, say, a go/no-go test, then the Fluke 900 will capture that fault when the conditions on the board that cause the device to fail occur.

18. How are RAMs, especially DRAMs tested?

This can be done by running the UUT's diagnostic routine. While memory locations in the DUT and RD are written and read in parallel, the 900 compares them at full speed, like any other device. As noted above, a defective RAM causing a failed go/no-go test will necessarily be addressed and written in a way that recreates the fault.

19. How does the Fluke 900 distinguish between a blown output and a blown input?

The test results will be the same. The device driving a faulty node will fail, while the driven device will pass. In practice, most failures are output related, so the results are not misleading.

20. How does the Fluke 900 handle bus faults?

A fault at a particular node usually indicates the possible failure of several devices. The Fluke 900 provides a "time to fault" reading to aid in identifying the first fault in certain failure modes. The 900's Gate function can also be used to focus a comparison test on an individual device on the bus.

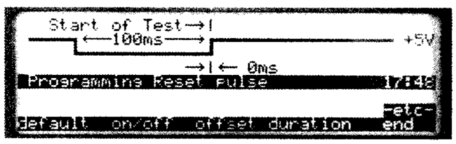
21. Can the Fluke 900 he used to pre-screen devices?

Yes, in a limited way. The RD Test feature performs a low speed (10 KHz) truth table test of the device in the ZIF socket. This will identify blown devices and static faults, but not timing or parametric faults. As mentioned in the answer to question 6, an RD can also be tested by clipping onto a known good board.

Programming

22. How long does it take to create a board Test Sequence?

A basic Test Sequence can be created for a typical board (with approximately 100 devices) in 1 to 2 days. Any optional enhancements, such as operator prompts and automated diagnostic tree guidance will take another day or two.



Selecting the parameters for the Reset pulse. The comparison test for most components starts by actiuating the reset logic on the board under test.

23. Can a PC be used as a programming station?

Yes. This is most effective for final editing enhancements, done with any screen editor or word processing package. Test Sequence files are uploaded via the RS-232 port to your PC, edited, and then downloaded back to the Fluke 900.

24. How many Test Sequences fit on a cartridge?

For a typical board with approximately 100 devices, one cartridge (32K bytes capacity) will hold 5 to 10 run-only version sequences, or 3 to 4 editable source versions.

25. Can Test Sequences be protected against tampering?

Yes, in two ways. The Write Protect switch on each cartridge prevents accidental erasure. And Test Sequences can be distributed to the test floor as "compiled" run-only versions, which cannot be modified.

26. Can I create a Test Sequence for a hoard with limited documentation or no schematic?

Yes. It requires someone who understands the use of the Fluke 900 well, and can interpret generic databook information about board devices.

Depend on Fluke for complete service and support

Fluke offers you more than just great tools for digital troubleshooting. The Fluke 900 comes with training courses, application assistance and maintenance support to help you apply your troubleshooter to your operation.

So that you can get the maximum use out of your Dynamic Troubleshooter right away, Fluke offers a hands-on training course on troubleshooting with the 900. You are entitled to a certificate for this two day course with the purchase of each 900. Contact your sales engineer for more information on Fluke's full schedule of training courses.

In-depth application assistance is only a phone call away. Fluke's Customer Support Services organization at our network of technical centers can provide you with complete support.

For service, that same network of technical centers makes it easy for you to maintain and service your 900 no matter where your operation is located.

Specifications

Dimensions

Main Unit:
12x15x3.5inches
30.5 x 38.1x 8.9 cm
Interface Buffer:
8 x8 x 0.75 inches
20.3 x 20.3 x 1.9 cm
Cable Length: 48 inches I I22 cm
Weight: I2 lbs I 5.44 kgs
Power: 115/230 VAC, 47 to 63 Hz, 100W
Storage Temp.: -40°C to + 70°C
Operating Temp.: 0°C to + 50°C

Electronic parameters

Devices supported: SSI to VLSI digital components, up to 28 pins, capable of driving one LS load.

- N, S, F, LS, AS, ALS, HC, HCT, ACT, FACT, Open Collector TTL, and equivalent CMOS devices.
- Custom components: PAL, HAL, PLA, FPLA, and Gate Arrays.
- Memory: static & dynamic RAM, ROM, PROM, EPROM, FIFO.

Devices with weaker drive (down to I/3 normal fanout) can be tested with "RD Drive Low" mode; this reduces normal input signal bandwidth of 20 MHz by 30 %.

Fault detection: Adjustable from 20 to 200 nsec, with 10 nsec resolution.

DUT tested: At data rate of up to 20 MHz. (20 MHz bandwidth on connections to DUT)

Minimum pulse width: 20 nsec

Minimum slew rate: lOV/usec

Pin loading on UUT: 10KΩ ± 30 pf.

DUT input connections protected to ± 25V. Device logic levels: programmable 0 to 5V, in 100mV steps, with 100 mV accuracy.

Device Test Time: Programmable from 1 to 9999 msec, or continuous; synchronization and initialization times from 10 to 9990 msec.

Elapsed time-to-fault reading: 40 nsec resolution.

Trigger Circuit: User-specifiable, two words of 28 pins on the DUT plus 1 external node; test cycle begins once trigger condition(s) are met.

Gate Circuit: User-specifiable, one word of 28 pins on the DUT plus 1 external node. Comparison test is performed only while gate condition is True.

Reset Circuit: Programmable polarity, duration, and timing (timing is relative to synchronization interval); tri-stated when not active. Pulse duration is programmable from 100 msec to 3.27 sec.

Can use either internal power or from the UUT:

- Internal-supplied from 5 V source; sink/source 50 mA.
- External -supplied from UUT (2 to 15V); sink/source 50 mA.

RD supplied with up to 400 mA at 5V (±5%); power applied only during RD test & comparison test of test cycle.

RD test vector patterns can be up to 2K in depth.

Frequency counter measurement to 25MHz, (.5 %; 20 nsec. minimum pulse width for frequencies > 20 MHz)

Ordering Information

Model

900 **Main unit, including**
: **Interface buffer**
: **Test Clips: (-16D,-24D,-28D)**
: **(Y900-001)**
: **Cords(Y900-005)**
: **Ref. Device Tray and**
(Y9OO-003)
:
:
:

Y900-001	**One Data Cartridge**
Y900-002	**Set of Three (3) Data Cartidges (in tray Y900-004)**
Y900-003	**Ref. Device Tray & Cartridge Holder**
Y900-004	**Cartridge Holder (for 3 cartridges)**
Y900-005	**Set of Five (5) Patch Cords and Clips**
Y900-006	**Model 900 Carrying/ Shipping Case**

Dip Clips:

Y900-8D	**Test Clip, 8 Pin DIP (0.3")**
Y900-14D	**Test Clip, 14 Pin DIP(0.3")**
Y900-16D	**Test Clip, 16 Pin DIP (0.3")**
Y900-20D	**Test Clip, 20 Pin DIP (0.3")**
Y900-24D	**Test Clip, 24 Pin DIP(0.3")**
Y900-24DW	**Test Clip, 24 Pin DIP (0.3")**
Y900-28D	**Test Clip, 26 Pin DIP (0.6")**

S.M.D Clips:

Y900-8S	**Test Clip, 8 Pin S.O.I.C. (0.1")**
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Y990-16SW	**Test Clip, 16Pin S.O.I.C. (0.2")**
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