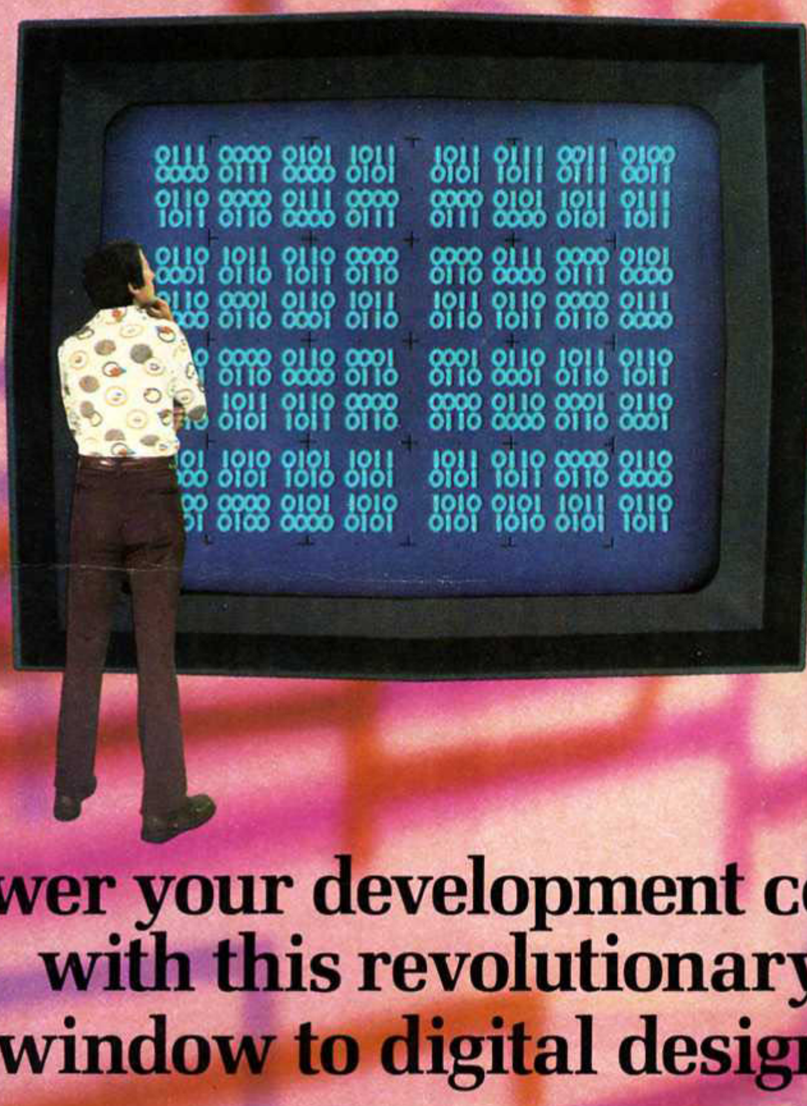
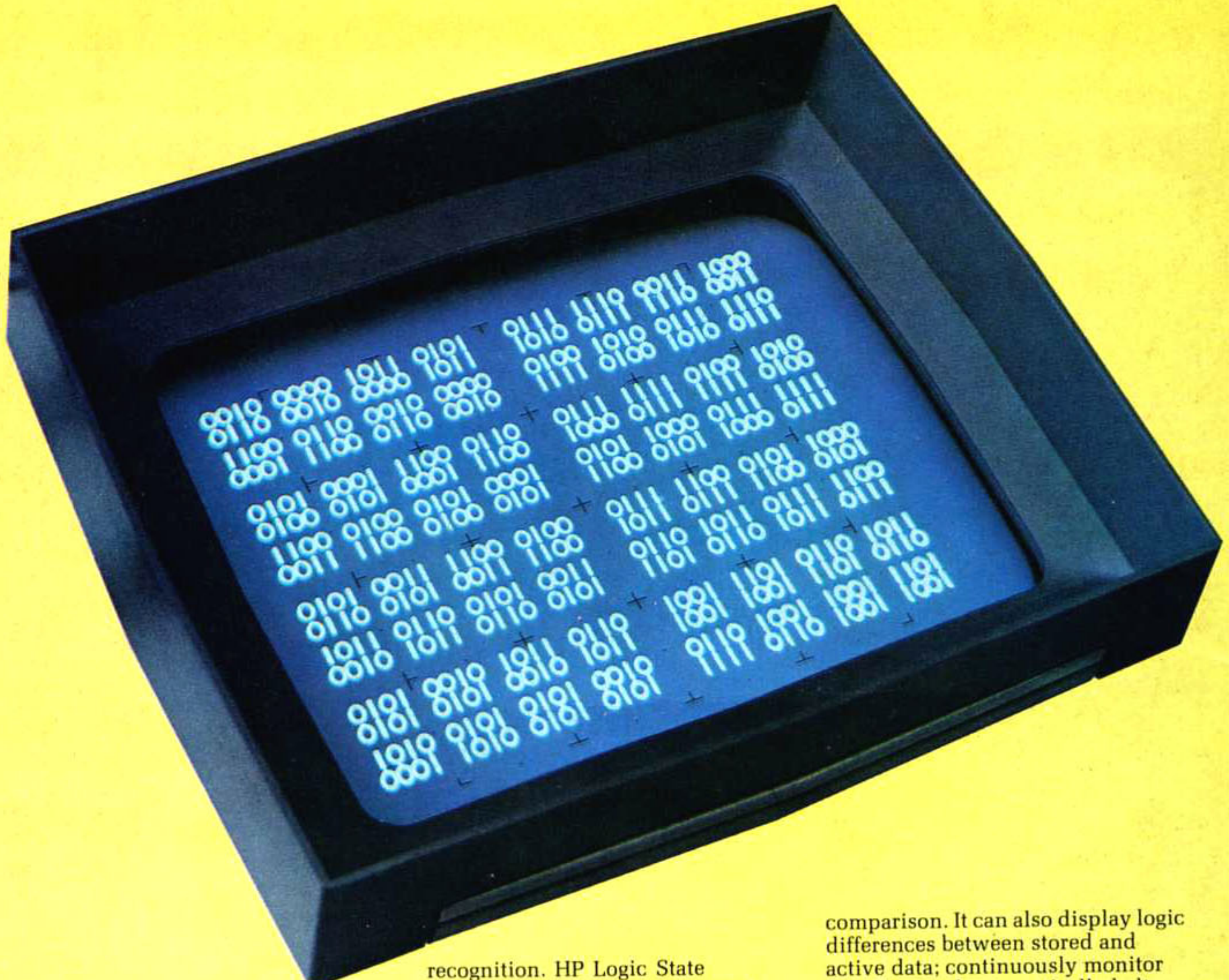


Lower your development costs with this revolutionary window to digital design.

HEWLETT hp PACKARD

If you rely primarily on a scope for digital design. we think you're making a mistake.



Now we're not advocating that you stop using your scope. You've always needed one and you always will. But if a scope is all you're using, you're probably wasting a lot of time. A couple of years of field experience with logic state analyzers has shown us that about 85% of digital troubleshooting problems can be solved faster with a logic state analyzer than with a scope.

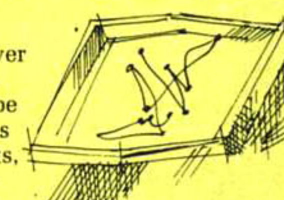
Think about it. When you want to observe action on address or data buses, or on control lines, which instruments give you more meaningful data—a scope with four input channels or a logic state analyzer with 12, 16, or 32 channels?

You need a trigger that's related to program steps. Scopes by themselves simply don't have the capability of triggering on pattern recognition. HP Logic State Analyzers do. Suppose you want to delay the data display to a specific point after the trigger word. The scope's analog time delay system has the inherent problem of display jitter. This is completely eliminated by the stable clock-pulse delay of a logic state analyzer. And when you're viewing data, would you rather mentally convert waveforms to digital words (1's and 0's) or have the instrument do the conversion for you?

Obviously, the scope is the logical choice for electrical measurements such as voltage level, rise time, and timing measurements. But when you're viewing state flow, there's no substitute for a logic state analyzer.

For example, one of HP's Logic State Analyzers can store one table of digital words and display it next to your active word display for comparison. It can also display logic differences between stored and active data; continuously monitor data flow and automatically halt when the active data does not equal the stored data.

A new technique called mapping gives you an entirely new view of operating logic circuits—over 65,000 data words can be displayed as discrete dots, each representing one input word.



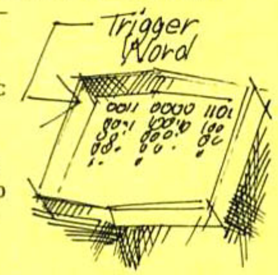
You can easily recognize these dot patterns after some familiarization, thus providing a rapid way to spot system irregularities. And for locating "lost programs," the map provides unequaled speed.

But these aren't just interesting measurement techniques, HP Logic State Analyzers provide more capability than any other digital troubleshooting instrument can deliver.

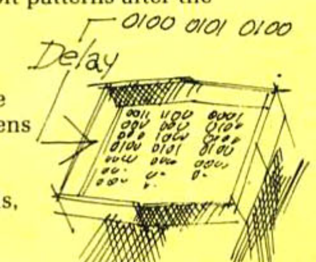
The Logic State Analyzer is the only economic alternative when it comes to digital system design.

Your digital system operates in the data domain. You know all about time domain and frequency domain measurements, but how do you define data domain measurements? Basically they are measurements of logic state as a function of discrete intervals of time—clock cycles, for example. The emphasis is on word parameters. While the scope gives you an analog display of amplitude vs. time (time-domain dimensions), the logic state analyzer gives you a display of digital words vs. clock cycles.

But what are the other requirements of a data domain instrument? Obviously you need sufficient channels to see what's happening on address and data buses. With today's systems, that means 16 channels or more. You need data registration—the ability to trigger on a specific bit pattern and the ability to position the display window as a function of clock cycles (pattern recognition triggering and digital delay).



Because you often encounter events that occur only once in a program, you need a method of internal storage. Obviously, you want the ability to look at bit patterns after the trigger point, but you also want to see what happens before that point . . . in other words, you want negative time display; and even the ability to look on both sides of the trigger word at the same time.

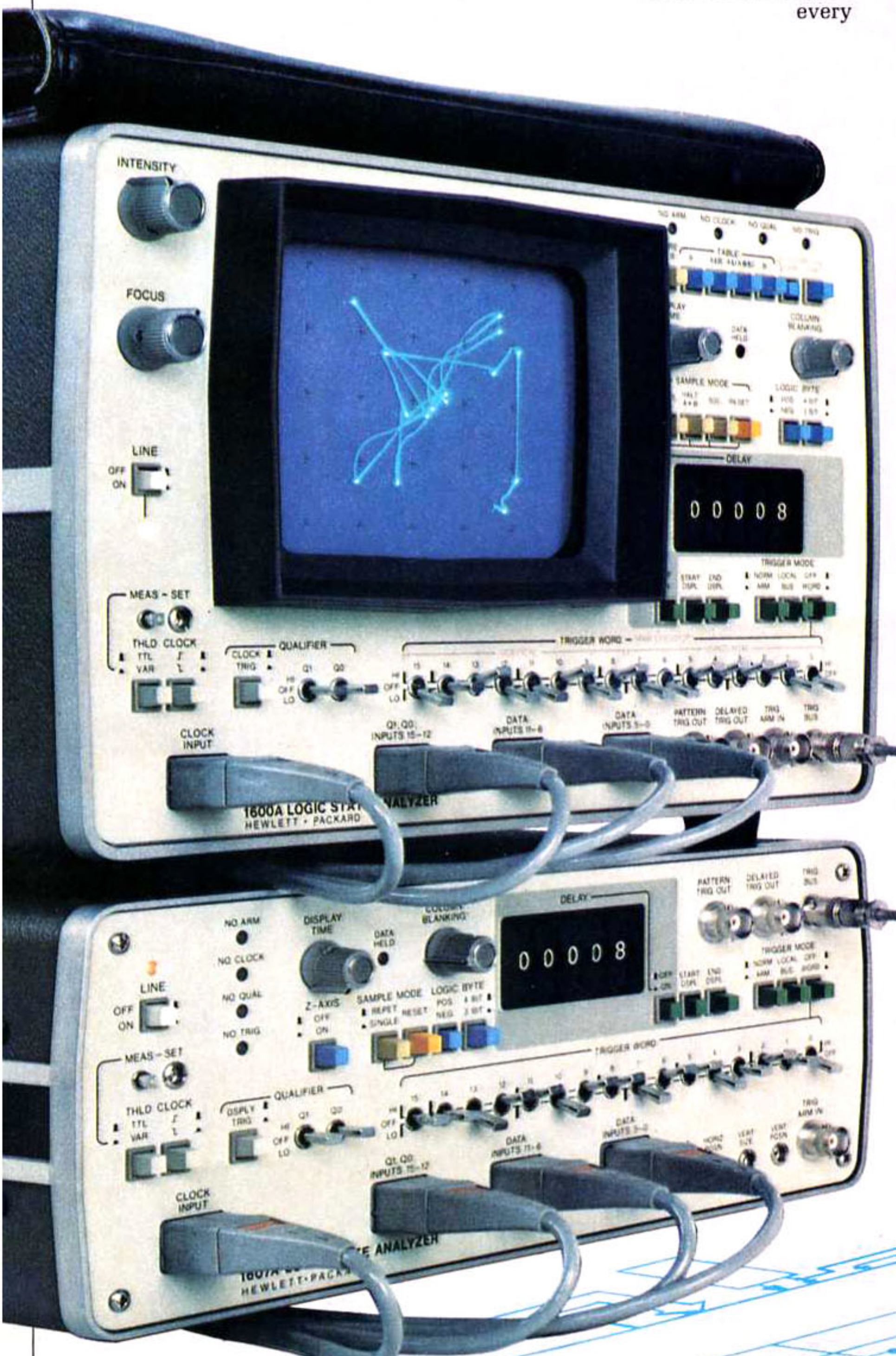


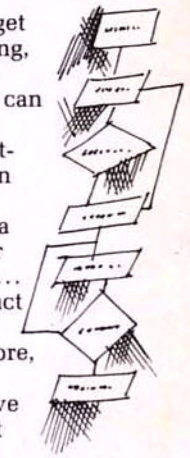
It's essential that you be able to qualify both the trigger point and the display so you won't trigger on, or display, unwanted data. You'll still need to observe time-domain waveforms on your scope for detailed electrical measurements such as rise times, logic levels, and for locating glitch-generating race conditions. Your data domain instrument should therefore be able to drive a time-domain instrument—providing a trigger upon pattern recognition. Finally, you want data displayed in a functional format (a display of states) to simplify analysis.

From the previous comparison with a scope, you can see that these are the requirements we've used at HP in developing our family of Logic State Analyzers. Obviously, some members of the family have more capability than others, and prices vary accordingly. But the point is, all have been designed specifically to help speed digital design and debugging by giving you a better view of your system's operation. A view in the data domain . . . where your program flow is happening.

HP's Logic State Analyzers speed digital design.

Software debugging. It's great if you write a program that works right the first time it's implemented in hardware. But you know that it doesn't happen every time. And when you get into program debugging, it's usually a time consuming task. How can an HP Logic State Analyzer help? By putting a window right on the data and address buses and giving you a real-time view of your program in operation... so you can see the exact word flow while it's happening. What's more, HP Logic State Analyzers let you move the window around at will by triggering on any word you want, or delaying the display a specific number of words beyond the trigger word.





This lets you compare the actual addresses and data on the buses with the program instructions you entered. It becomes much easier to spot an erroneous data word, an erroneous jump in the program, or an unending loop. With the mapping capability of the HP Model 1600A Logic State Analyzer, it's a simple matter to compare an executing program pattern to a known good pattern, or spot unique points in the pattern that indicate problems in an executing program. The 1600A also gives you the ability to locate any word on the map and trigger on that word so you can pinpoint a potential error source quickly. Then you can zero in by using the table display (1's and 0's), and digital delay to examine the program sequence in detail.

Watching your software in action ...it gives you a big edge in problem solving.

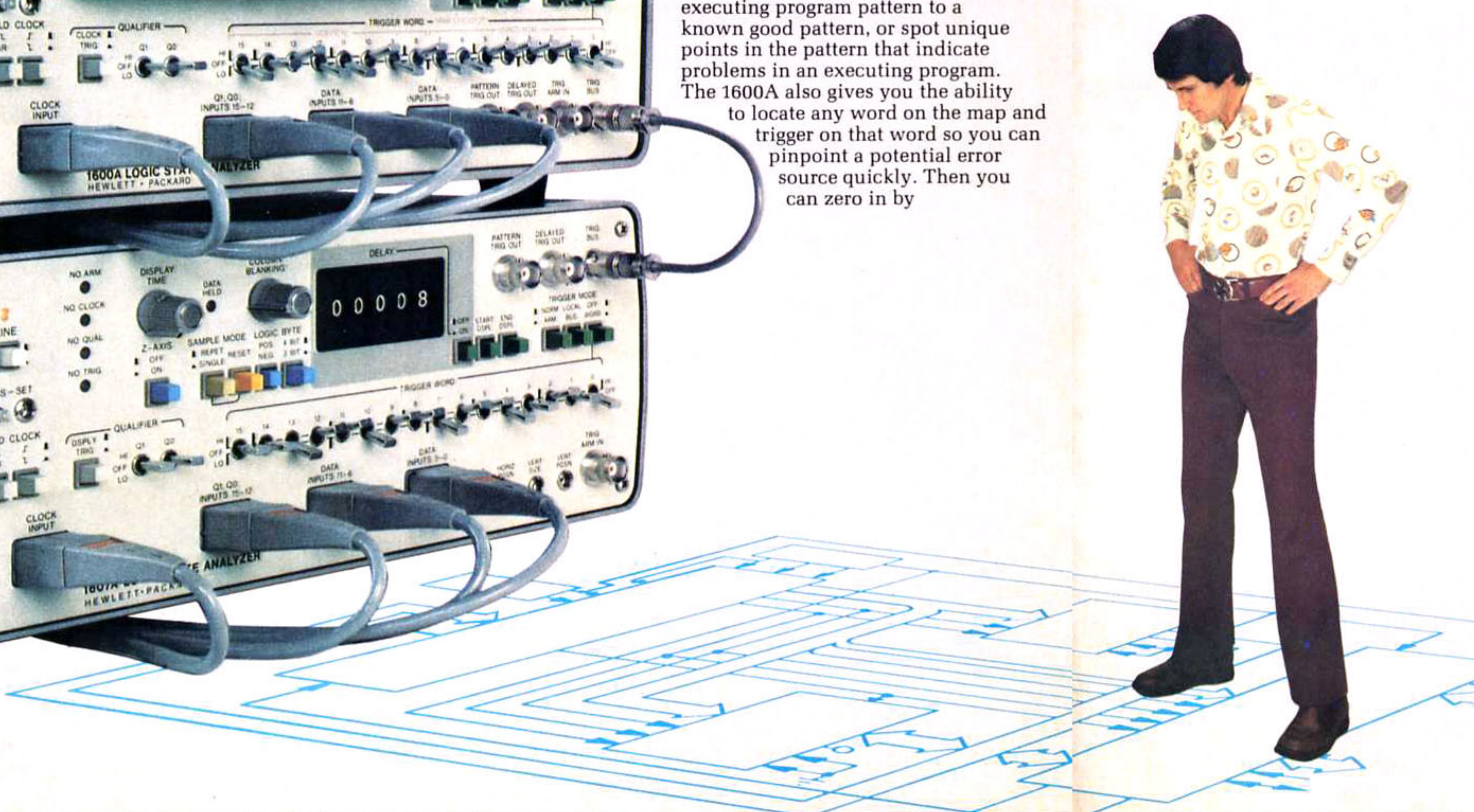
Hardware/software marriage. In digital design, you often discover incompatibilities between hardware and software—particularly when separate design teams have responsibility for these two aspects of the system.

It's not uncommon for the software to command the hardware to look for a signal (such as a request for interrupt) that apparently never occurs. Failure to get the signal may be a timing problem—the signal may occur too early or too late. The signal may exist at the right time, but at the wrong place—on the wrong data line for example. Or perhaps the signal was omitted altogether in hardware implementation. With microprocessors, the problem may be due to lack of understanding of CPU peculiarities.

Whatever the case, you could spend an inordinate amount of time looking for the answer with the channel and triggering limitations of time-domain instrumentation.

However, with an HP Logic State Analyzer, you can tie into both the address and data buses at the same time, plus flag or qualifiers (up to 32 channels can be displayed on one screen). You can then run a short test program, trigger on a specific word at the beginning of the program, and view the program implementation leading up to the problem.

With this detailed picture of software in action, it's a simple matter to observe the displayed program sequence and see what's happening to that signal at a specific point in time. Then it's usually easy to spot the problem and apply a software or hardware solution—whichever is more appropriate.

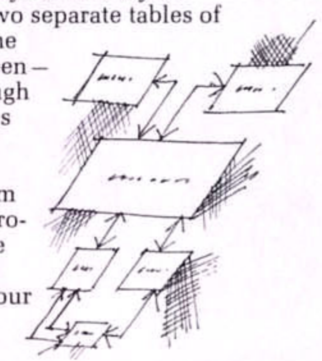


System interaction. Additional problems frequently show up when you start transferring information across an I/O port. And your troubleshooting problems are compounded because you have two sources of data to monitor at the same time. They may have independent clocks ...be asynchronous...but require a common trigger signal.

How do you verify overall system operation? How do you find out if data has been properly transferred from one part of the system to the other? And how do you determine whether or not the instructions have been executed properly?

Suppose, for example, you've designed a microcomputer-controlled test system for production. How do you know that the software is giving proper instructions to the instruments under test? Or that the instruments are inputting data correctly to the microcomputer? Unless you can verify the states in your program flow and look at digital inputs and outputs during the test cycle, your test could be meaningless. But with your microcomputer operating at one clock rate and the monitoring instrumentation at some other rate, how do you observe both and relate microcomputer software to hardware output.

The answer is HP's 1600S Logic State Analyzer. It lets you display two separate tables of data on the same screen—even though clock rates are different or one system is asynchronous. One table can display your microcomputer software sequence while the other displays the hardware output and input resulting from that software. With program flow displayed alongside the input and output states of the instruments being controlled, there's no doubt about a correct testing sequence...or about the information being fed back to the microcomputer. Furthermore, if there is a fault, you have adequate information to diagnose problems for correction.



In all of these phases of digital design—from the time you input software right through system checkout—an HP Logic State Analyzer can give you a clear view of program flow and hardware logic states to simplify design and debugging.

Pioneers in the data domain are convinced.

Our customers have been using HP Logic State Analyzers since 1973. And we've talked to quite a number of users to find out what designers need in data-domain instrumentation. We've also found out how these data-domain pioneers feel about the HP Logic State Analyzers.

Here's a sampling:

"With the 1600A analyzer, I can do in an hour what I couldn't do in 3 months otherwise, and that's a fact."

"I designed a buffer interface that allows us to make real time tests using a slower tester. With my $20,000 interface, the $100,000 tester and your $4,000 logic analyzer, we can do the job of a $400,000 real time tester."

Don Glancy,
Principal Engineer

"We encountered some severe software problems on a real time 4K system where we were at a loss as to how to approach the problem. Because it was a real time system we were unable to stop it to use the standard software debug techniques. By coincidence your salesman called on the same day to demonstrate the 1601 Logic Analyzer. We hooked the analyzer to the system under test and wound up solving the problem that same afternoon. We were so thoroughly convinced of the potential power of the 1601 as it applied to software debug that we ended up buying two of them."

"Even though we had limited experience with microprocessor design, there's no question the logic analyzer saved us valuable design time."

Ken Fiske,
Senior Design Engineer

"When a parity error does occur, our equipment re-reads the data block fifteen times. In order to initiate that search routine, many sequential logic events must occur. Problems occasionally arise in that logic flow and it's been very difficult to analyze using just a scope. The logic analyzer allows us to troubleshoot logic flow in parity error problems about twenty times faster than the scope does. In addition to being faster, it's also easier to interpret the 1's and 0's than it is to interpret waveforms."

Don Stewart
Coordinator of Service Planning

You've just read actual testimonials from users who have achieved significant time savings with an HP Logic State Analyzer—savings ranging from a factor of 20 to well over 400 compared to other methods, (Don Glancy's comment, "I can do in an hour what I couldn't do in three months otherwise.") And equipment savings of a factor of 3 or more.

If you or your people spend significant numbers of hours in the development of bus-structured systems such as computers and microprocessor-based systems, consider what those time savings could mean to you:

Convince yourself.

Over and over again, the reports from the field say: time saving... greater productivity...reduced development time...products into production faster. Whether you're a digital designer or an engineering manager, this message is important to you.

As a circuit designer, you know the importance of sticking to development schedules and budgets. And that always means solving the problems the fastest way you know how. Take a look and see what kind of savings you might realize with an HP Logic State Analyzer.

If you're an engineering manager, concerned with the productivity of your engineering department, consider how much further your engineering budget could go if your people had HP Logic State Analyzers.

(A)	______	**Estimated man hours spent in evaluating and debugging hardware and software using conventional techniques.**
÷	______	**Your estimated time-saving factor—using a logic state analyzer—based on these testimonials.**
= (B)	______	**Estimated time spent in evaluating and debugging hardware and software with a logic state analyzer.**
(A)−(B)=	______	**Potential time savings during the project.**
×	______	**Your hourly rate including overhead.**
=	______	**Potential direct cost savings.**

Make your own analysis of what the time savings can mean in terms of getting products into production faster. The figures you come up with might easily exceed the cost of one of our Logic State Analyzers.

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P.O. Box 529

Join the data domain revolution.

Your choice in data domain instrumentation is growing steadily. It extends from simple 4-bit AND gate trigger probes, to an optional Logic State Switch on HP scopes for selecting either time or data domain, to the 1600S – the system with up to 32 channels plus qualifier inputs, storage, delay, and two modes of display (table or map). There's an instrument or accessory in this family to put you in the data domain and give you a much better view of your digital designs.

We've just scratched the surface.

There's a lot more to know about the data domain and about HP's family of instruments. And there are several sources for more information.

Seminars. HP instructors are now conducting one-day seminars on logic state analyzers and their application, and will continue in 1976.

Technical Data Sheets. These publications give you details of operation and instrument specifications on each of the family members.

Application Notes. A number of notes cover the use of mapping, using logic state analyzers to troubleshoot mini computer systems, microprocessor systems, etc.

For more technical data, simply mail the attached reply card, indicating the data sheets you want. Or, for even faster action, contact your local HP field engineer and ask him for more details about the instruments or seminars. Give him a call today and join the data domain revolution.

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I'd like more technical information about HP's family of data-domain instruments. Please send data sheets on:

- ☐ Logic State Analyzers
- ☐ Pattern Trigger Accessories
- ☐ Clips and Probes

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