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BENCH BRIEFS

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COMPUTER AIDED TESTING

ON THE THRESHOLD

by John Minck and Neil Neilson

It has finally happened. Automation is knocking at the door of calibration laboratories.

For many years most of us have watched automation moving through production facilities, machine shops, and some times quality control labs and engineering labs. We've seen computers proliferating in data centers, not only for payroll and inventory matters, but beginning to move into instrumentation and data-taking with ever increasing speed. As repair and calibration technicians, we may have smugly sat back and said to ourselves that they'll never automate my job, largely because of its intricate interactions of knowledge, training, and instrument complexity.

But now several well-known companies have recognized the potential of such automatic calibration systems and are starting to put them on a production basis. Hewlett-Packard is no exception for we have been working hard to implement the idea of computerized testing.

This might be a good time to take a direct look at this dramatic new trend to see what it means in human terms. A lot of times a good way to do this is to write down just what it represents and what it does not represent.

Computer aided testing is:

1. A way of coping with tremendously increasing instrument complexity and workloads which threaten to overwhelm the operation of typical calibration labs.
2. A system for handling volumes of data and test card information, and linking directly with administrative systems presently set up for inventory calibration recall.
3. A way of relieving the routine and tedious procedures that require so much knob twiddling and meter reading.

An automatic system is not:

1. A substitute for human judgment on quality and performance of an instrument.
2. A substitute for the diagnostic skills of an experienced technician.
3. A job threat for the technician.

(con't on next page)

(con't from page 1)

who is looking for new opportunities and challenges.

What the computer-aided systems really represent are augmentations and productivity increasers for calibration labs. As workloads pick up and the economy improves, most management is going to be very hesitant on rebuilding overhead operations. Automatic systems represent an excellent way of improving productivities without adding substantially to overhead. At the same time, they represent a real challenge for dealing with a future trend that is all but unstoppable.

You may wonder if this new tool will be useful to you personally. The first thing it will do is give you the opportunity to learn more about computers and program writing. Hewlett-Packard's system uses a programming language (called HP ATS BASIC) that is easy to learn in a couple of days and allows a measurement-oriented person to write good programs. In fact, most of the programs at HP are being written not by programming specialists but rather by test technicians who better understand the instruments.

If you prepare yourself and are the man selected to use these systems, you'll find they relieve you of the boring portions of the calibration jobs and enhance that portion which most technicians enjoy. Using these programs that you or other technicians have written, the system will let the operator check an instrument to specifications. The system itself then produces copies of the test results with out-of-spec results being flagged. The diagnostic technician can now do the troubleshooting with more good information to work with.

Most automatic systems are at their best when they are running high production throughputs of good instruments. Therefore, defective instruments would generally be handed off to separate manual repair benches. After such repairs, the system will again make final checks to make sure that everything is back in specification.

The automatic systems represent an outstanding challenge in more than just areas of computer technology. You find that when writing a new program you must pull yourself away from old techniques. As an example, instead of using traditional time mark techniques on slow sweeps for oscilloscopes, a system can easily measure the slope of the sweep ramp at the CRT plates. Of course, the CRT deflection voltages are previously calibrated in terms of volts per centimeter of deflection. An interesting fallout of this technique is that, since the system is detecting the slope of the sweep ramp as soon as an adjustment is made to change the sweep speed, the system immediately senses the slope change and tells whether the adjustment is correct without waiting for the full sweep to complete.

Perhaps it is really time to begin thinking of your own place in this new technology. Systems of this type have the potential of doing many things and they are going to involve a lot of people in the planning and execution of the future. Some of these jobs are listed below and you will probably think of many more.

1. Training reduction, because of programmed techniques.
2. Retention and standardization of procedures.
3. Receiving inspection speed-up.
4. Final inspection data taking.
5. Equipment inventory and calibration data management.

Probably the most exciting thing about the systems is the potential for the future. As this potential develops, all of us must become better technicians with increased knowledge of computers and systems.

New products will have testpoints brought to umbilical connectors for system access. Troubleshooting procedures may change significantly. More digital circuits can only be tested by a computer because there are so many states it would require a lifetime of manual testing.

The professional technician* will see these trends as challenges—challenges that are at the same time stimulating and rewarding.

John Minck and Neil Nelson are both 15-year veterans of Hewlett-Packard. John choosing to go into sales, and Neil into service. John is currently the Marketing Manager for Instrument Calibration Systems in our Automatic Measurements Division, while Neil is Manager of the Repair Center Technical Staff at the Customer Service Center.

* See *Bench Briefs* July 1972

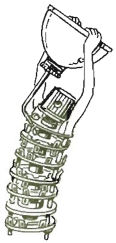
WHAT'S A LEAP SECOND?

5061/5065 Frequency Standards

This year is a leap year but did you know that last June 30 had a leap second? That's when the world's atomic clocks, such as HP's rubidium and cesium beam standards, were held up for one second to match the time measured by the less-stable rotation of the earth. Just as the leap year adds a day every four years, the leap second adds a second every now and then to correct for a lag in the earth's rotation.

If you have an HP Model 5061 or 5065 clock, you can delay a second by pushing the STOP pushbutton to delete one pulse. Since pulses occur in 1-second intervals, do not hold down for longer than one second.

ROTARY SWITCHES: Cleaning & Lubricating



HOLD IT! Before you throw away that rotary switch, make sure that it can't be reclaimed by simple cleaning and lubricating. Intermittent or high-resistance contacts can be caused by galling, formation of silver sulfide, or deterioration of contact lubricant. In these cases, the switch can be reclaimed by using Freon spray to clean the switch and Electrolube liquid or spray for lubrication. The process is described briefly as follows or you can order Service Note M45B for complete instructions.

1. Spray switch contacts and rotors with Freon TF (HP No. 8500-0232) to remove dirt particles and traces of the old lubricant. Use a paper towel or other absorbent material as a backdrop to catch all removed material. Avoid spraying components made of plastic materials.
2. Rotate the switch several times and allow time to dry completely.
3. For all low-impedance switches, and particularly for switches with contacts difficult to access, use Electrolube 2A aerosol spray (HP No. 6040-0300) on the contact wiper blades. Again, avoid contact with plastic materials.
4. For high-impedance switches, or for switches with accessible contacts, apply a thin coat of Electrolube 2G (HP No. 5060-6086) to the wiper blades and the inside of each contact, using a No. 1 or No. 0 artist's brush.
5. Rotate the switch repeatedly to distribute the lubricant.

When treated early enough, and on a regular basis, this process can indefinitely extend the life of your rotary switches. (Good for push-buttons, too.) The only restriction we can suggest is where switches are exposed to dusty environments. In these cases, the lubricant tends to attract dust, which in turn ruins contacts in a short time.

Electrolube is recommended because it includes an anti-static agent that discourages collection of contaminants, and also has a silver sulfide remover that progressively improves contact resistance with use. Electrolube has about the same conductivity as transformer oil and therefore should be used with caution around high-impedance (>10^7 ohms) circuits.

MICROWAVE TEST EQUIPMENT

420 Series & 8470 Series Crystal Detectors

Crystal detectors can be damaged by static charge, therefore an ungrounded soldering iron should never be used to solder leads on a crystal. A grounded DC soldering iron is preferred, although a grounded AC iron is acceptable. Before touching the iron to the crystal lead, the iron should first be touched to the crystal body to discharge any static charge present.

SWEEP OSCILLATORS

8690 Series BWO RF Plug-ins

The recommended replacement BWO for all H89-8693B RF Units is HP stock number 1951-0084. Although this BWO is designed for extended frequency operation, its cathode is also constructed to withstand longer periods of time in the standby mode.

COUNTER and DVM REMOTE PROGRAMMING

Having trouble checking the programmability of that DVM or counter? Our Customer Service Center has developed a universal programmer that will simulate the logic levels specified in the instruction manual. This test set works by shorting lines to ground, or you can also inject a voltage to check the high state. Most HP instruments with the remote programming feature are covered. For a parts list, drawings, and prices, write to Rich Black, Hewlett-Packard Customer Service Center, 333 Logue Avenue, Mountain View, California, 94040.

RECYCLING MERCURY BATTERIES

Help stop mercury contamination by recycling your used mercury batteries! If you're wondering what to do with a stockpile of accumulating mercury, at least one manufacturer has set up a program to reclaim this persistent element. You will be paid 45 cents per pound for old mercury batteries sent postpaid to this address:

Mallory Battery Company
U.S. Highway 64 East
Plant 2
Lexington, North Carolina
27292

CHANGES ARE COMING

Advice for today's technician on preparing for tomorrow's technology—by *George Stanley*

Have you recently opened the schematic on a modern piece of electronic test equipment and wondered what all those strange symbols were? If you have, you are not alone, especially those of you with an analog as against a digital background. Even with a digital background, you aren't immune to the changes brought on by the impact of integrated circuits.

Vacuum tubes disappeared completely in the last decade and transistors took their place. Today, transistors are rapidly disappearing and integrated circuits are in turn replacing them. You might say "So what? What does that mean to me? Well, today's schematics consist mainly of operational amplifiers, logic symbology, and Boolean equations. Often as not, there is not even a transistor symbol on the page. This is just as true for a microwave signal generator as for a binary counter.

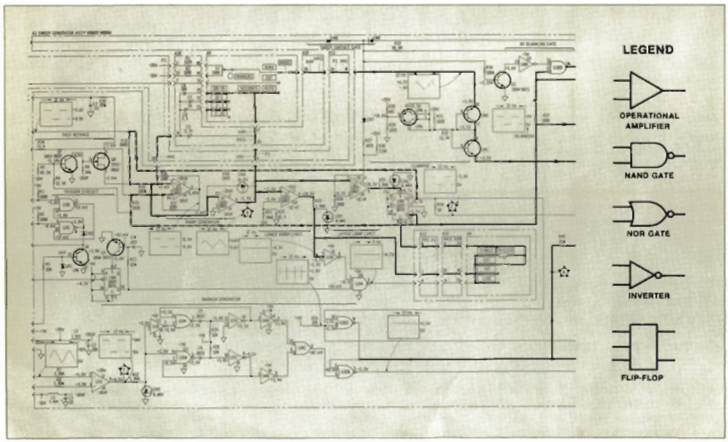
What does this mean to the technician who is trying to stay current with the ever changing world of electronics? (Electronics isn't the only area changing rapidly today—all technical areas are.) Frankly, if you can't count in binary, can't recognize an "OR" from a "NOR", and haven't heard of a "virtual ground" in an op amp", you are going to have a hard time with today's and tomorrow's test equipment.

As an example, consider the HP Model 8620A Sweep Oscillator. Depending on which plug-in is used, it can cover a frequency range from 100MHz to 18GHz. Normally you would think of this as a microwave instrument and just look at the schematic portion for the Sweep Generator Assembly shown with this article. Besides the usual transistors and FET's, it shows 12 operational amplifiers, 5 NANDS, 5 NORS, and 2 J-K flip flops, plus a healthy sprinkling of clamp diodes, zener diodes, and switching diodes.

After you get checked out in the area of new symbology you are going to have to get checked out with new electronic tools. The tools coming into vogue today are logic probes, logic clips, logic comparators, bit totalizers and so forth.

You needn't be alarmed by these changes; just look at them as new and exciting opportunities. After all, you learned how to recognize NPN from PNP, learned how to use transistor curve tracers and ohmmeters to check diode junctions. This is just another technology 'upgrade' that will be presented to you in the years ahead. Those of you who periodically extend your education in these new areas will find an increasing number of exciting and rewarding job opportunities.

Mr. Stanley is Training Manager for the Electronic Products Group which includes all of Hewlett-Packard's instrument-producing divisions. BENCH BRIEFS will try to keep you up to date on new troubleshooting tools and techniques for transistorized and integrated circuits.



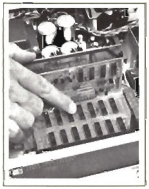
NEW I.C. LIST AVAILABLE

10529A Logic Comparator

The guys responsible for selling and servicing the HP Model 10529A Logic Comparator have compiled a list of the integrated circuits that are testable with the comparator. Over 350 IC's listed by HP stock number, are included in the list. For your copy, write directly to Robin Adler, Hewlett-Packard Santa Clara Division, 5301 Stevens Creek Blvd, Santa Clara Calif, 95050, and request the list and any other logic troubleshooting information you desire.

For those not familiar with the Model 10529A Logic Comparator, it is a hand-held tool that checks out the logic states of an IC dynamically without unsoldering. It works by borrowing power and input signals from the IC being tested. Outputs of the test IC are compared to those of a reference IC within the comparator. Any differences in logic state are displayed on 16 LED's corresponding to the 14 or 16 pins of the dual-in-line IC.

An ON light shows if the clip is properly attached. Any other light indicates an output pin of the IC being tested that doesn't act like the same pin of the reference IC.



1.

2.

3.

With reference to the photo sequence on the right, the following 5-step approach takes less than 30 seconds per IC.

1. *Locate the IC to be tested and read its type number.*
2. *Select a reference board containing a good IC of the same number.*
3. *Insert the reference board in the comparator.*
4. *Attach the clip to the IC to be tested.*
5. *Read the LED display.*

4.

5.

I.C. TARNISH

Industry is constantly looking for methods of getting the highest reliability with lowest cost. Consequently over the past few years the leads on integrated circuits have changed from gold plating to silver plating. With exposure to air, silver plating begins to tarnish much like dining silverware. This tarnish is caused by sulphur in the air which causes silver sulfide to form on the IC lead. While this tarnish poses no problem to reliability once it has been soldered on a printed circuit board it does, in some extreme case , make soldering difficult.

The manufacturers of these types of IC's have packaged them so they are not exposed to air. Once these packages are opened however, the silver sulfide begins to form. This can be prevented by placing loose IC's in an air tight container with sulphur-absorbent paper or mothballs. If tarnish has been allowed to form, a rosin flux type solder should be used to improve solderability. In extreme cases the leads may have to be cleaned with a commercial solution for silver cleaning (available through jewelers) prior to soldering.

Once the IC's are loaded on a printed circuit board, exposure to air is certain. The ambient sulphur content then has a direct affect on the rate of tarnish. While tarnished silver diminishes considerably in eye appeal, we have the manufacturer's assurance that reliability is not reduced.

SYNTHESIZED SIGNAL GENERATORS

8660A Basic Mainframe
86601A RF Section
86631B Auxiliary Section.

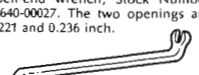
The 8660A Mainframes and 86601A RF Sections with serial prefixes listed below require modification before they can be used with the 86631B Auxiliary Section to generate a pulse modulated output.

8660A Mainframes with serial prefixes 1141A and below require Modification Kit HP 08660-60240.

86601A RF Sections with serial prefixes 1202A and 1214A require Modification Kit HP 86601-60092. RF Sections with serial prefixes below 1202A require extensive modification and must be returned to the factory.

SUB-MINIATURE CONNECTORS (SMC)

Removal and installation of subminiature threaded connectors is easiest when using the small offset open-end wrench, Stock Number 08640-00027. The two openings are 0.221 and 0.236 inch.



ON-INDICATOR
427A VOLTMETERS

A customer from the Electrical Engineering Department at the University of Colorado, Professor J.T. Crofter of the Instrument and Calibration Lab, offers a tip for the HP Model 427A Voltmeter.

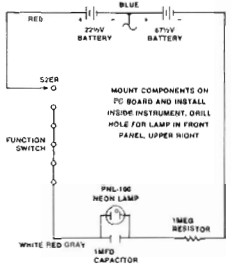
The Problem: With no ON indicator built into the battery-powered 427A, students were inadvertently leaving the instruments energized, thus causing high battery consumption.

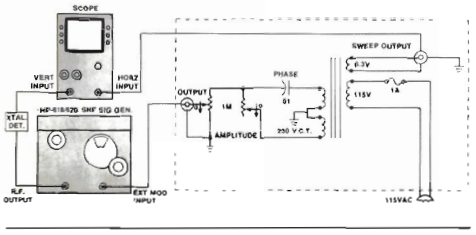
The Solution: Add a flashing neon lamp to the front panel, bright enough to attract attention, yet with a low current drain to conserve power. By adding a separate battery-powered circuit in series with the FUNCTION switch, an ideal indicator was conceived. A 1-megohm resistor and 1-millifarad capacitor was inserted to give a rep rate slow enough so that battery life is nearly as long as shelf life. Five units have been in constant service for over a year with the original batteries. Total cost of the modification was less than $4 per unit.

SIGNAL GENERATORS
618 and 620 series

(This article is repeated from a prior issue due to popular customer request.)

It is often desirable, and sometimes necessary, to observe the entire repeller mode of a klystron signal source on a scope when adjusting the repeller tracking voltages (for example, with the HP Models 618 and 620 SHF Signal Generators). A little "black box" that is worth its weight in gold, is an FM Modulator. The gadget we use consists of a small HP power transformer (Stock No. 9100-0045) connected with the primary and secondary windings interchanged; two 1 megohm potentiometers; a 0.01 μf capacitor; two BNC connectors; a fuseholder; a power cord; and a box of some sort to put all this stuff in. Connected as shown, this modulator provides a power line frequency modulation voltage continuously variable in amplitude from 0 to 320V peak-to-peak, with phase variable over a range of approximately 80 degrees, plus a 6.3 vac output for scope sweep.





Thank you, Prof. Crofter, for a tip that may prove useful to other owners of the 427A, or any instrument lacking an ON indicator. BENCH BRIEFS appreciates the chance to publish customer ideas such as this. If you have a useful modification or service hint, please enclose it in the self-addressed mailer on the back page or mail directly to: Editor, Bench Briefs, c/o Hewlett-Packard Bldg. 5U, 1501 Page Mill Road, Palo Alto, California, 94304.

RECOMMENDED READING

The books recommended are not stocked or offered for sale by Hewlett-Packard Co. Please consult your local bookstores or contact the publisher directly for copies.

DO-IT-YOURSELF DIGITAL TEXT

A new book on digital circuits promises to be interesting and fun—basic theory plus complete instructions on how to create and combine circuits such as gating networks, counters, encoders/decoders, and registers. Discussions on theory are followed by experiments which substitute actual hardware in place of the logic symbols.

DIGITAL ELECTRONICS: Principles and Practice, by Brice Ward, published by TAB Books, Blue ridge Summit, Pa, price $8.95 hardbound or $5.95 paperback.

TECHNICIANS DATA BOOK

Not a brand new book, but one worth rediscovery, is the following reference text on basic electronic equations. This book attempts to bridge the gap between electronic theory and the practical world of the professional technician, by illustrating the most frequently used equations along with brief and clear explanations.

DATA BOOK FOR ELECTRONIC TECHNICIANS AND ENGINEERS, by John D Lenk published by Prentice-Hall, Inc., 1964, Englewood Cliffs, N.J., price $10.95 hardback

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HP AMATEUR RADIO CLUB (K6FB)

HAM operators from local HP divisions gathered in a forest clearing in the hills above Saratoga, California last June 23 for Field Day exercises. Sponsored by the American Radio Relay League, the Field Day annually tests the emergency capability of the club over a 24-hour period. Approximately 20 members, operating on 3.5 mHz to 144 mHz (80 thru 2 meter bands) kept three transmitters in simultaneous operation around the clock. The operators made 1,207 contacts in nearly all the States of the Union as well as Sweden and England to the East, Japan and New Zealand to the West, and Cuba and the Canal Zone to the South. The HP club members would be happy to hear from customers who are HAM ops also—for business or pleasure! by WB6JSZ

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DO YOU TROUBLESHOOT TO THE SUBASSEMBLY LEVEL? ☐ ALWAYS ☐ SOMETIMES ☐ NEVER

DO YOU TROUBLESHOOT THE SUBASSEMBLY AFTER REPLACING? ☐ ALWAYS ☐ SOMETIMES ☐ NEVER

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