Engineering News

ANALYZING THE FREQUENCY DOMAIN
(What is a Spectrum Analyzer?)

By Robert Bales

Question: How do you measure the frequency response of a diseased plant?

Answer: With a spectrum analyzer.

That is one of the more unusual reported applications of the instrument. Spectrum analyzers are used to analyze all kinds of signals, either directly or with the aid of transducers. For example, low-frequency analyzers are used in such diverse areas as the study of speech and the investigation of mechanical vibrations.

In communication systems, an antenna and a spectrum analyzer can determine the number and frequencies of transmitters in a band, along with their relative or absolute strengths at a given location. The analyzer can also look for interference, either from electrical equipment or transmitters not included in the system.

For any one transmitter (or signal generator), the analyzer can measure power output, stability, the level of harmonics and other spurious outputs, the level of hum and noise on the carrier (the 7L13, with 30 Hz resolution, can detect 60 Hz sidebands on carriers up to 1.8 GHz) and can make modulation measurements on AM, FM, and pulse modulation.

HOW TO MAKE A SPECTRUM ANALYZER

The basic principle of the sweeping-signal spectrum analyzer is illustrated by the radio receiver-oscilloscope com-
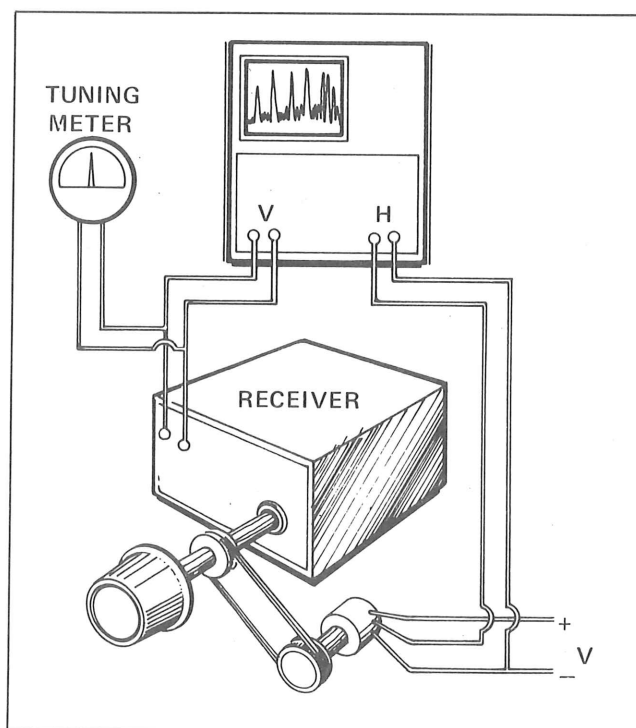

Figure 1. An instrument resembling a spectrum analyzer could be made by sending signals proportional to tuning and signal strength from a receiver to an oscilloscope.

bination of Figure 1. The tuning control via the potentiometer produces a voltage proportional to the received frequency. The oscilloscope adjustments are set so that the left →

edge of the screen corresponds to the lowest frequency tuned and the right edge to the highest. The screen is thus calibrated in frequency/division. When the receiver is tuned, the beam will move across the screen. Whenever a station is received, the voltage from the tuning meter will deflect the beam upward by an amount proportional to the signal strength. The resulting display will be similar to the photograph in Figure 2, which was obtained by connecting an antenna to the 7L5 Spectrum Analyzer and sweeping across the broadcast band.
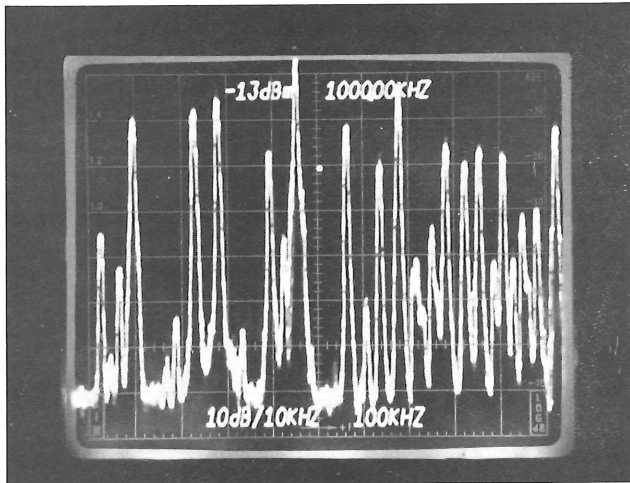

Figure 2. This display of signals received in the broadcast band was obtained on the roof of building 58.

ANALYZER CIRCUITRY

Figure 3 is a more detailed block diagram of a typical spectrum analyzer. The blocks represent two types of circuits — control circuits and signal circuits. The control circuits consist of the logic, sweep generator and attenuator, oscillators and drivers, and switching circuits necessary to make the instrument function. The signal circuits are the mixers, amplifiers, filters, and other stages which process the signals to form the CRT picture.
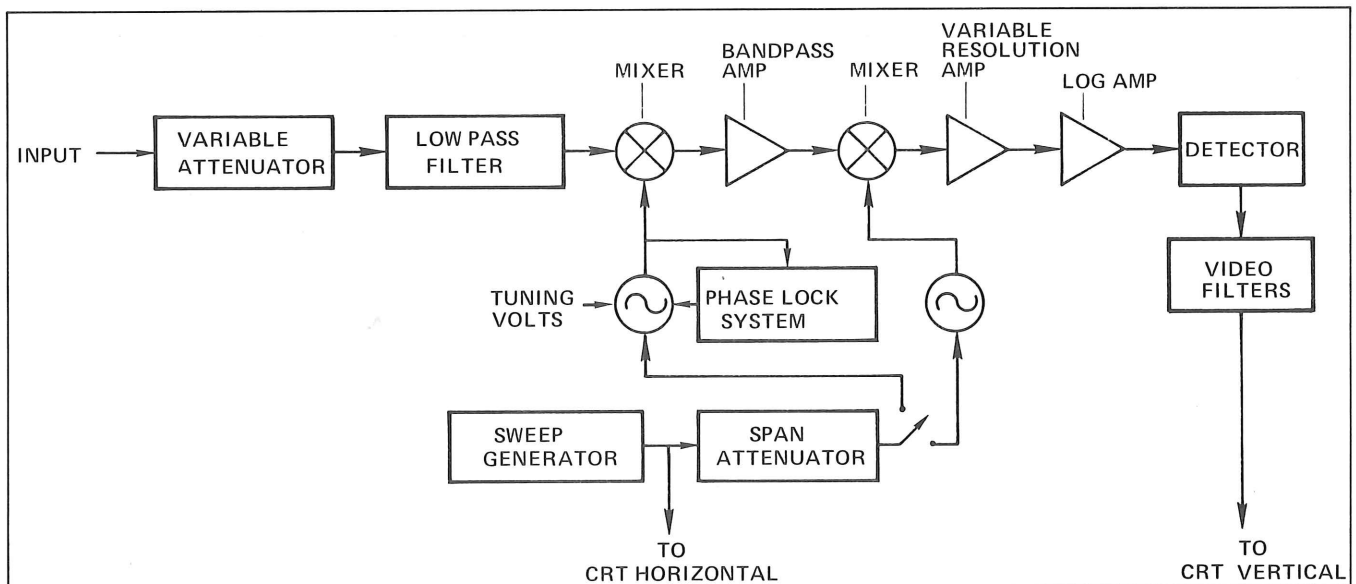
Like the radio receiver, the spectrum analyzer examines signals sequentially, but the tuning capacitor-potentiometer combination is replaced by electrically-tuned oscillators. For applications where only a narrow frequency range is to be covered at low frequencies, variable capacitance diodes are used for tuning. At higher oscillator frequencies much better linearity can be obtained with YIG — Yttrium-Iron-Garnet— oscillators. The YIG material resonates at a frequency which varies linearly with the magnetic field caused by current in an electromagnet. A typical oscillator tunes from 2 to 4 GHz, with a sensitivity of 20 MHz/ma.

A sawtooth waveform is used to sweep both the oscillator and the CRT horizontal. An attenuator changes the oscillator sweep and hence its frequency deviation to set the span, or frequency/division. Spans in a single instrument can range from 100 MHz (or more)/div to 200 Hz/div. There is also a zero span position in which the analyzer, with no sweep applied, serves as a variable-frequency receiver.

Because it must sweep and tune, the main oscillator does not have the stability of a fixed oscillator, such as a crystal oscillator. Drift of the oscillator is indistinguishable from drift of the signal. Hence, most spectrum analyzers contain a system which phase locks the first oscillator to the harmonic of a crystal oscillator at narrow spans. This gives the locked oscillator approximately the same fractional stability as the crystal. The sweep is applied to another oscillator. Because this second oscillator sweeps over a smaller range, it has greater stability.

Another way to obtain oscillator stability along with highly accurate frequency readout, is to use a frequency synthesizer as a local oscillator. With a synthesizer, the center frequency is referenced to a crystal oscillator in all span settings. This approach is used in the 7L5.

In the design of the signal circuits, the mixer is usually placed ahead of all amplifiers. The mixer is inherently nonlinear: second-order nonlinearities are necessary to produce the →

Figure 3. This simplified block diagram of a spectrum analyzer represents general principles, not a specific Tek product.

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mixing action. However, higher-order nonlinearities are always present to cause distortion. The lower the signal level into the mixer, the less is the distortion. The drawback to having the mixer first is that it is vulnerable to burnout by high input levels. (Many analyzers have 50 ohm inputs. These should never be connected to a dc voltage unless they contain a blocking capacitor, which Tek's analyzers do not. Even with a capacitor, sudden application of a dc voltage can couple enough energy through the capacitor to harm the mixer. The attenuator in front of the mixer, while protecting the mixer, is itself susceptible to burnout.)

The heterodyne action of the first stages of the analyzer produces a representation of the input signal which contains a frequency component for every frequency component in the input, but which is translated in frequency and which sweeps past the fixed resolution filter, a deflection is produced on the analyzer screen each time a frequency component falls within the filter passband. If two components are so close in frequency that they are simultaneously within the passband, only one indication is produced. Hence, a narrow resolution bandwidth is needed to see fine detail of the input signal. However, there are other applications in which a wider filter is desirable. For example, when the analyzer is used in the zero span mode, the filter must pass the highest modulating frequency. A typical bandwidth range is that of the 7L12, 3 MHz to 300 Hz, variable in decade steps. The resolution of the 5L4, an audio analyzer, is continuously variable down to 10 Hz.

The most common reason for using a wide filter is the reduction in sweep time it permits. (To obtain an accurate representation of the input, each signal must be in the filter passband long enough for the filter response to reach its steady-state value. This takes longer to occur for narrow filters. With no video filters in use the required sweep time is proportional to the inverse of the square of the resolution bandwidth. Video filters are low pass filters between the detector and the display.) The important thing is the sweep speed of the signal in Hz/second; this depends on the span as well as the sweep time. Figure 4 illustrates the effects of sweeping too rapidly. Because of the slow sweep speeds required for some resolution-span combinations, storage CRT's are often used. The 7L5 has built-in digital storage.
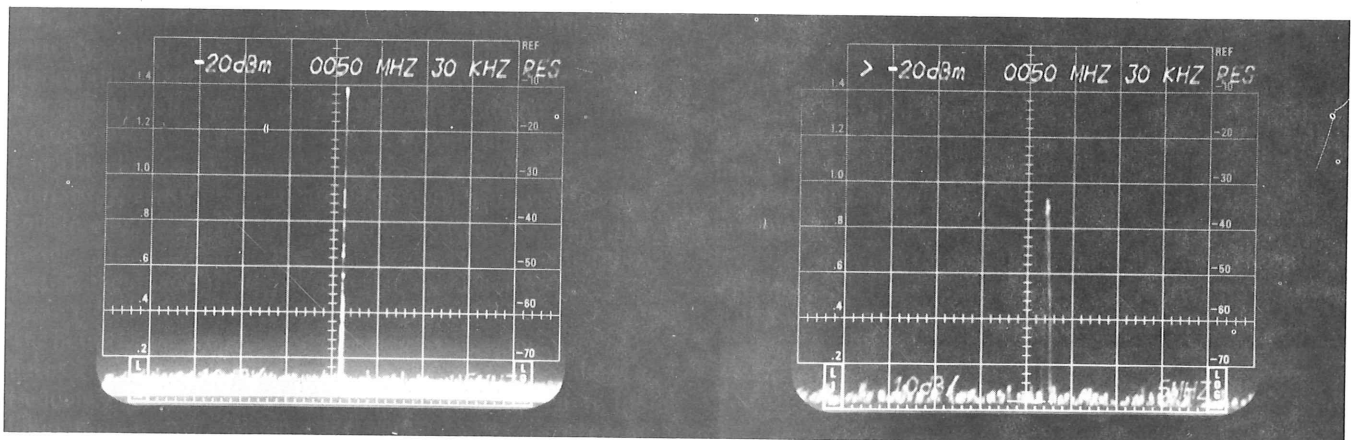
OTHER SPECTRUM ANALYZER USES

Spectrum analyzers are frequently used to measure the performance of small-signal circuits. Figure 5 shows the results of a measurement of the two-tone intermodulation distortion of an amplifier. The two strong signals are the amplified inputs at frequencies f_1 and f_2. The weak signals, at frequencies $2f_1 - f_2$ and $2f_2 - f_1$, are generated by third-order nonlinearities in the amplifier. The relationship between the levels of the desired and undesired signals at a given input level defines a figure of merit. Harmonic distortion and linearity can also be easily measured.
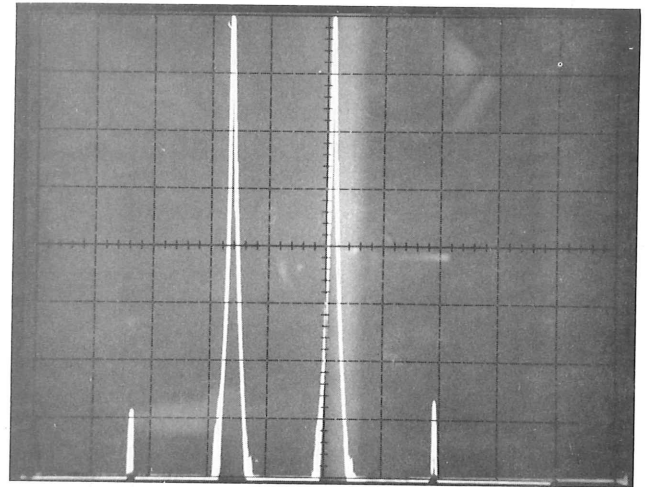

Figure 5. Third-order nonlinearities in an amplifier will cause intermodulation distortion (the creation of frequency components—the two weak signals—in the output which were not present in the input).

Used as a detector in conjunction with other equipment, the analyzer can make a number of miscellaneous measurements. The advantage of the analyzer as a detector is that it has a wide dynamic range and can cover a wide frequency range, yet is a narrowband device (narrow resolution bandwidth) and consequently has low noise.

An important auxiliary item is the tracking generator. This instrument uses the local oscillators from the spectrum analyzer and generates the necessary frequency offsets to produce a signal the same frequency as, and in synchronism →
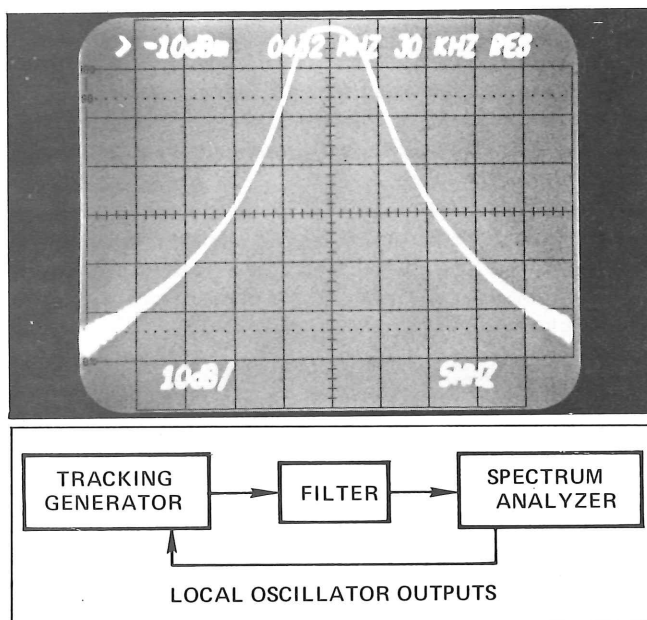

Figure 4. When the analyzer sweep speed is too high, the normal display on the left is changed to the distorted display on the right.

with, the frequency passing through the analyzer at any instant. The analyzer-tracking generator combination is used for frequency response measurements. Figure 6 shows the response of a bandpass filter.

Using the proper analyzer, many of the above measurements can be made at either audio or RF frequencies. Tektronix publishes several application notes describing communications system test in both frequency ranges.

Figure 6. The tracking generator is used to measure the frequency response of various components, such as filters.
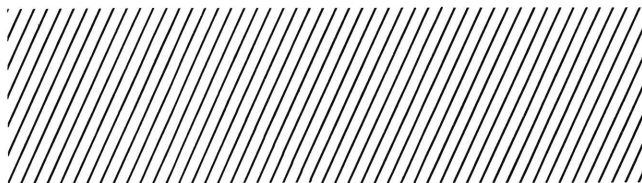
Further Information

For more information on spectrum analyzers and their uses, drop by and have a chat with anyone in FDI (Frequency Domain Instrumentation) engineering on the second floor of building 58, at 58-733.
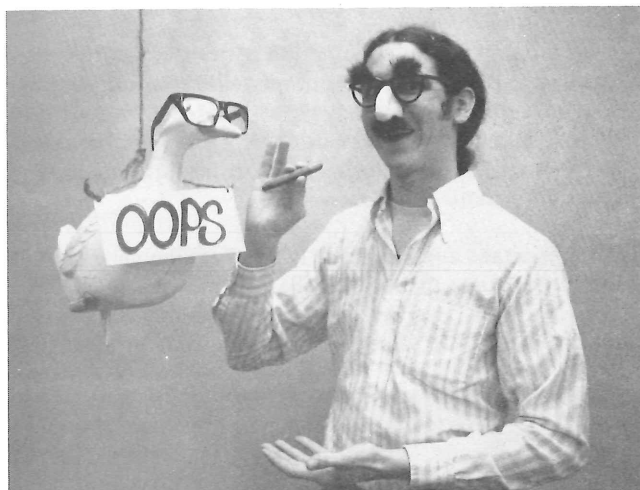
The Flip~Flop that Flopped

Figure 1. The author is the one on the right.

Engineers usually have a bag of tricks — new and/or unusual way of accomplishing certain functions in an elegant, or non-standard way. Over the years, one collects an assortment of these goodies, and they can get you out of a tight place every so often. Or into one. While you usually hear about the triumphs, no one likes to talk about the failures. However, the failures add to your experience and help make you a better engineer (sometimes more than the triumphs do). So it is in this spirit that I'd like to tell you about my latest screw up.

The situation was rather tight. Deep into A phase, it was discovered that an interface required a 2 μsec wide pulse to be generated about every 8 ms by a carry out pulse edge from a counter. The pulse width was not critical. There was no board space available and we were drawing too much power already. So I did what any other engineer would do: I looked for unused gates already on the board.

I came up with exactly one flip-flop. What I really needed was a one-shot function, so I began to think of ways to turn a single flip-flop into a 2 μsec one shot. And I came up with the circuit in Figure 1.

Every 8 ms the positive-going edge clocks Q hi and $\overline{Q}$ low. The $\overline{Q}$ discharges C via R until the CLEAR threshold is reached (this is a TTL flip-flop, so the CLEAR is active LO.) Then the CLEAR makes Q LO and $\overline{Q}$ HI, which then charges C via R, thereby releasing the active CLEAR. Then it's ready to go on the next clock pulse. One can set R by the maximum sink current allowed by the output pulldown transistor and juggle C to achieve the approximate pulse width.

No engineer worth his salt would trust a paper design. So I breadboarded it using a 74LS74 (156-0388-00). Eureka! It worked, and with reasonable values of R = 1.3K and C = 1000 pF. I filed the A phase change order with just a hint of the smugness that comes when you know you're getting away with something.

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Alas! Just as in Greek tragedy, the protagonist hastens his own demise. None of the B phase boards worked. A quick check showed why: Signetics parts were being used rather than the TI part I had breadboarded. The solid state implementation of the CLEAR function in the Signetics chip was different, as evidenced by the fact that the Signetics CLEAR floats at +1.8 V, whereas the TI CLEAR would float at +5 V. Reduction of the resistor R to 390 Ω to allow more current drain (through the loop consisting of R, the CLEAR input circuitry and the Q output stage) failed to cure the problem. Substitution of the rest of the TTL 74LS74 implementations, such as low power, standard, or Schottky, didn't help one iota. So there I was, with the same problem and several weeks less time to deal with it.

The moral is clear: In the future, I'll have to be more thorough when I'm being sneaky.

Like the man says, everyone hears about the triumphs, but people are usually reluctant to publicize the ideas that didn't work. We can learn as much or more from our mistakes as our successes. If you have some design idea that didn't quite make it, and you think others could benefit from your experience, give Engineering News a call at ext. 6071 or 6601. We can help you organize the information, and if you'd rather not have your name on it, we'll even help you with an alias. —Ed.
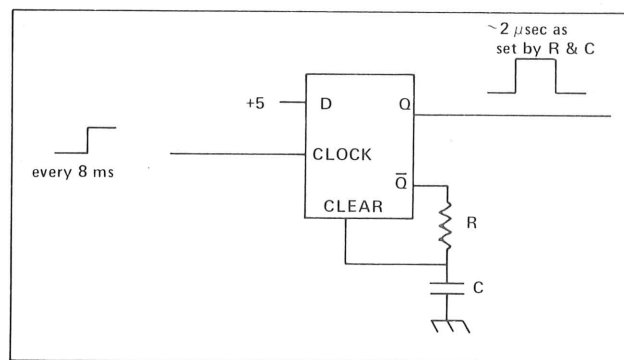

Figure 2. One-shot operation using a D flip-flop.

WRITING FOR PUBLICATION
"Electronic Design"

This is the second in a series of articles telling you how to break into print and achieve fame and fortune. Editors of trade journals are always looking for new ideas in the form of articles, news items and design ideas, and the Technical Information office is set up to help you to provide these. What is Electronic Design looking for?

Technical Articles

Articles for Electronic Design must be useful to electronics engineers and engineering managers and should, in fact, help them with their work. The most acceptable articles tell how to do something — how to design, measure, test, use, specify, select, package, etc. In addition, articles must be timely, i.e., not "old hat." They should be of broad interest, and practical (not so elementary or theoretical that they cannot be easily reduced to practice). Unproven theories or results obtained with products not commercially available are not acceptable. Analyses should include alternative solutions, where practical, and might even mention alternate products where they are relevant.

How Long Should The Article Be?

Long enough to cover the subject, but preferably no longer. The usual maximum for articles is the same as EDN — about six printed pages. This is eight to ten typed pages (double spaced) plus photos, diagrams, curves.

How Much Do They Pay?

$30 per printed page with a maximum of $200 in one issue, for any article except ideas for Design.

Ideas for Design

These are new or important circuit or design techniques, the clever use of a new component or test equipment, packaging tips, cost saving ideas. You will be paid $20 for each published idea, $30 more if it is voted best of issue, and if it wins the idea of the year award, $1000 more.

That's about it. Again, when you are thinking of writing for a particular magazine, read through a few issues carefully to see if this is, in fact, the right market.

Bring your rough drafts or article ideas in to the Technical Information Office, 50-462. We'll help you with the rewrite, contact the editors, check for patent protection and confidentiality and you'll be on your way.

IN PRINT

Hiro Moriyasu, Engineering Manager of the Service Instrument Division wrote an article which appeared in the April issue of CANADIAN ELECTRONICS ENGINEERING magazine entitled "Know the application key to successful microprocessor based instrumentation." Hiro says that the primary advantage of microprocessor-based instrumentation is an increase in instrument function, while making instruments much easier to use. He mentioned some of the uses of microprocessors at Tektronix, along with some specific tasks microprocessors are, or will soom be performing in test and measurement equipment. He emphasizes that the needs of the customer and versatility of the instrument must be weighed against the cost of developing a microprocessor-based instrument.

Mel Balsiger, Display Devices Engineering, and Kevin Considine, Display Research co-authored an article which appears in the April 1976 issue of R/D (Research/Development) entitled "High Brightness, Long Life from New T-F Emitter." They review theory behind field emission electron sources, thermal FE technology in particular. They built a practical T-FE gun, and point to possible applications.

Warren Finke, and **Jake Tausch,** both of M. C. Engineering contributed most of the information for an article written by Gary Wolfe, Assistant Editor of Circuits Manufacturing magazine. The article, entitled "Scaling the Mountains of Test Data" appeared in the April issue. To characterize IC wafers during development phases, "mountains" of test data results are summarized on two- and three-dimensional plots. These graphs tell how many devices on the wafer are within a parameter category, which locations on a wafer will yield bad ICs, indicate process variations, and plot many other characteristics of an IC wafer. Warren and Jake feel that computer graphic displays have played a key role in accelerating the development and production of new IC designs at Tektronix.

Dr. Leslie Ball Visits Tektronix: RELIABILITY MANAGEMENT

On April 15 and 16 Dr. Leslie W. Ball of the University of Pennsylvania spoke at Tektronix on Reliability Management, a six hour seminar in two parts. He discussed managing new product development, with this method which evolved when the U.S. had serious reliability problems with military equipment in the Korean War. The Reliability Management method was developed to assure improvements in reliability, but then was broadened to include all aspects of developing a new product. The technique was and is used to help prevent cost overruns, schedule slippages, safety problems, failure to meet performance goals, manufacturing problems, and field maintenance problems, as well as to assure adequate reliability.

Dr. Ball dealt at length on the various aspects of Program Management. He then showed how reliability considerations fit into the total product development plan. He illustrated his talk with examples from his experiences in Reliability and Safety Assurance Management with Boeing and NASA in the space program. Some of the key points he mentioned:

1) Retain experience so that others can use the lessons learned. Keep records of both mistakes and successes and index them so they can be accessed in the future.

2) Tek has become too large for communications on problems and successes to reach everyone who needs to know via coffee discussions. Thus, Tek must rely more on formal communications, published guidelines, and written directions.

3) Do we benefit in every possible way when problems are discovered? For example; if there is an instrument failure, do we fix the problem in that one instrument (quick fix); do we fix the problem in the design so the failure will not occur in other instruments (design change); or do we make changes in our Product Development procedure to prevent the problem from occurring in future designs (management action)?

4) Dr. Ball spoke at length on what he calls the Critical Activity Concept. These days products are developed in a very short time. This rapid development entails certain risks. Critical Activities are those activities that experience has shown must be subjected to formal discipline (management action) to assure that these risks are controlled. Dr. Ball said that management must:

   a) Identify Critical Activities. ⟶

b) Develop resources for each activity.

c) Require that all activities be performed, and audit the activities.

Each Critical Activity must have some criterion to specify when it has been successfully completed.

5) It is the responsibility of management to assure that the right people are assigned to the right activities, and that the proper relationship exists between the many people and activities.

He presented an indexing system for Critical Activities. It includes 39 Critical Activities which span five basic functions: program management, engineering, manufacturing, support, and use. These activities must be coordinated by management.

A few copies of the slides Dr. Ball presented at the seminar are available from Jim Averill, ext. 5186.

Reactions At Tek

Dr. Ball's seminar was discussed at the April 22 meeting of the Corporate Reliability Committee. In general, most of the committee thought that some form of Reliability Management Program could be of value at Tek, but they did not feel that the intent of the six hour seminar was to provide a "canned" program for Tek to implement. While some observed that Dr. Ball's examples were based on high budget space program and military design efforts, others pointed out that Dr.

Ball presented a technique for assuring a reliable product that should be gone over point by point and adapted where applicable for Tek use.

Some people felt that Dr. Ball did not present anything new to Tektronix, but rather "jelled" some ideas that we have been using on a scattered basis. They said that we already do some of the things that Dr. Ball suggests, but not on a regular basis. When Tek Schedules get tight or technical performance requirements are threatened, reliability efforts are often first to be sacrificed.

The Committee agreed with Dr. Ball that "...achieving reliability is recognized as a primary management responsibility." It was observed on one hand, "Anything that happens must come from the top down," and on the other hand that" ...the ideas and thought provoking must come from below. Rather than give Tek management specific tools to work with, or give employees specific tools to influence management with, Dr. Ball's contribution was primarily the concepts and the kinds of activities that must take place to improve reliability."

There are at present a number of people with reliability responsibilities at Tektronix. A successful Reliability Management Program would ensure: 1) that reliability people make appropriate inputs to the product development process, 2) that reliability people monitor and report on the adequacy of the product development process from a reliability standpoint, and 3) the activities and decisions which are critical to reliability are incorporated into every new instrument development program.

Industry To Rewrite UL1244

On April 13 Underwriters Laboratories held a meeting in Chicago with representatives of the electronics industry to discuss their proposed Test and Measurement equipment standard, UL1244. They invited members of the original ad hoc committee which rewrote UL1244 about a year ago. These people include Rich Nute from Tektronix, Marshall Johnson from Hewlett-Packard, and Dick Howard from LFE Corporation. Walt Riebe from Fluke Manufacturing Co., Pete DePaolo from Simpson Electric, Morris Triplett from Triplett, and Hope Broch from WEMA were also invited.

The representatives from industry arrived in Chicago a day early in order to prepare together for the meeting with UL the next day. Hope Broch (WEMA) asked Richard Nute two questions: 1) What is the worst thing that could happen at the meeting? 2) What is the best that could happen?

Rich says that the worst possibility would have been for UL to listen politely to industry's comments and then to finalize UL1244 as it now exists. Rich feels that UL1244 in its present form is an unworkable standard. The best thing that could happen would be for UL to fall back, regroup, and re-

structure the proposed standard to correspond with IEC348. IEC (International Electrotechnical Commission) 348 is the international standard for test and measurement equipment.

There is also an American National Standards Institute standard for Test and Measurement equipment called ANSI C39.5. Thus three separate safety documents affect our products: UL1244, IEC348, and ANSI C39.5. (Two additional international standards to which our products are subject are the British BS 4743 and the German VDE 0411.) All these standards are different, and we will eventually have to comply with them all. UL1244 is currently considered the worst. One goal of the April 13 meeting was to work toward standardizing the standards.

Present at the meeting from UL were Andy Farquhar, Vice President and Chief Electrical Engineer at UL; Bob Seelbach, Managing Engineer at the Chicago Underwriters office, who supervised the preparation of UL1244; and Bill Hogarty, Senior Project Engineer at the UL Santa Clara, California office. Bill Hogarty has handled the evaluation of our instru-

ments under UL1244, as well as those from Hewlett-Packard and John Fluke Manufacturing.

Seelbach began by summarizing what he hoped to accomplish at the meeting. He then turned the floor over to industry. Rich and other industrial representatives stated, "Basic ally, we would like to have our products certified to IEC348 in addition to listing by UL." Since about 50% of the business of the industries represented (42% of Tek sales in 1975) is outside the U.S., this appeared to be the vital issue.

In order for this to happen, UL1244 would have to conform better to IEC348. Industry told UL that IEC348, although not as bad as UL1244, had some problems. UL could not use IEC348 in its present form because it contains no test methods and relies on self-certification. This, it was asserted, was the reason that flaws in the standard had not yet become obvious.

The UL representatives accepted industry's position and stated that they recognized industry's need for IEC348 certification. From the subsequent discussion, UL agreed to re-write UL1244 to conform to IEC348, adding provisions from UL1244 concerning fire hazards and testing methods. The WEMA committee, of which Richard Nute is chairman, assumed the responsibility for rewriting UL1244. WEMA is scheduled to submit the rewritten version to UL for adoption in January 1977.

It is unprecedented for UL to turn the writing of a standard over to industry. This departure from tradition may be painful for UL, but by certifying products to an international standard they greatly expand their scope of operation. According to Rich, there is currently no testing laboratory anywhere in the world certifying to IEC348 or any other IEC document.

If the new standard is adopted, WEMA will suggest that CSA (Canadian Standards Association) use it also. CSA standards for Test and Measurement equipment are mainly concerned with primary circuitry. This new standard would tighten their requirements, but would also increase support for getting the rewritten UL1244 adopted by the IEC.

Class Changes in Grad Program

At an April 1 meeting the Tektronix Education Committee discussed plans for classes this summer and fall in the Graduate Program. The Advanced Solid State classes, EE514-515-516, given in 1973-74 by Ian Getreu and Bob Nordstrom, will be repeated in the fall. (Most coursework in the Graduate Program is planned to repeat on a three-year cycle.)

Three terms of Operating Systems classes in the MSCS program had previously been planned. The Committee recommended changing the first class, CS581 to Computer Graphics. The remaining two terms CS582-583, could be Operating Systems as originally planned. These changes will be made.

EE579, Special Topics in Computer Science is scheduled for the fall term. The Committee suggested planning a class on Artificial Intelligence.

The Committee decided that the Math sequence (to fulfill minors requirements) will continue during the '76 summer term. This was begun last year with Math 487 (Numerical Methods). Only a few students actually started and completed that course, but the Committee believed that the plant shut-downs, rather than lack of student interest, was the reason for low enrollment. Professor Joel Davis from OSU will teach Math 488 this summer. Math 487 (the first of the sequence 487-488-489) will not be a prerequisite to Math 488.

Attending the April 1 meeting were Harley Perkins, Engineering Services, Tektronix; Dick Elliot from the Oregon Graduate Center; Curtis Cook from the Oregon State Computer Science Department; Don Amort from the OSU Electrical Engineering Department; and several instructors and managers from Tektronix.

Questionnaire Results:

Harley reported the results of a questionnaire he had distributed to 400 Tek employees who are, or have been, enrolled in graduate courses through Tek Education. Approximately 41% of the questionnaries were returned. Of the respondents 47 were taking coursework in the MSEE-OSU program, 19 in the MSES-OGC program, 13 in the MSCS-OSU program, 73 in the MBA-UP program, 7 in the MSEE-UP program, and 7 in other programs. Ninety-eight were planning degrees, with one completed in the MSEE-OSU program. Eleven respondents stated that they had received degrees in the MBA-UP program. Not all the questionnaries were returned, so figures are not complete. Approximately 30 persons had actually earned MBAs in the University of Portland program as of April, 1976. More are expected sometime in May.

Most people answering the questionnaire felt that both they and Tektronix had benefited from the classes they had taken. There were suggestions on how to improve the graduate programs. The instructors' ability was mentioned more than once. (Some of the instructors are full-time Tek employees.) A few people suggested the instructors' communication skills did not match their technical competence and/or wondered →

about the procedure for their selection.

Some students who had not had related background education feel that the programs have greatly benefited both their work at Tektronix and their advancement opportunities. Others believe only students with directly related academic background should participate.

The fact that the courses are taught at Tektronix rather than on the University campuses encouraged some students to take classes they would not otherwise have been able to attend.

For more information on the Tektronix Graduate program or a schedule of classes, contact Harley Perkins, ext. 6186 or Kathy Teleck, ext. 5498.

HOWARD MEEHAN, HOWARD MEEHAN !

Howard Meehan, the new manager of Industrial Design, would like to see the role of Industrial Design expanded and designers become full participants in projects from the first stages of development. Too often, he feels, product groups tend to think of Industrial Designers as mere touch-up artists or interior decorators. As a result, engineers will all too frequently rush in at the last moment with a nearly completed project, demanding that the designer "Sex it up, give it some class and color."

But human engineering, Howard feels, should assume a more equal partnership with electrical and mechanical engineering. Industrial Designers have new ideas and expertise with new materials to contribute beyond their function of enhancing the appearance of Tek products.

For example, the Industrial Design group is capable of building three-dimensional models for evaluation of function and form. The fully-maintained shop can build "just about anything" out of cardboard, foam, wood, plastic, and aluminum.

In the area of new products, Howard believes, Industrial Design provides the important interface between man and technology. To more closely align the designers with the different product groups, Howard will assign them to product areas either part-time or full-time. In the past, the mission of Industrial designers has been vague. Howard is determined to foster a stronger image of its capabilities.

Panel Graphics

The most dramatic changes will probably be seen in the Panel Graphics area. They have recently added some new facilities which should result in a faster turn-around time for engineering panels.

An engineer who needs a front panel for a new instrument usually has a pretty good idea of the arrangement of the knobs and switches and the operation of the panel. He will discuss the layout with an Industrial Designer. At this point, the man-machine interface becomes critical. Are controls arranged and grouped in a functional manner? Are primary and secondary functions properly labelled? Is ease of operation for the user considered in the layout?

When the panel design is completed, the people in Panel Graphics will make a mockup two times size and then a Kodagraph film package as a prototype sample. Panel Graphics is now equipped to make its own film packages, silkscreen, and metal photo processes for prototype production.

The recently acquired photostat machine and Panel Processor machine have added a new dimension to Panel Graphics. It means a fast turn-around time for all engineering panels: no more waiting for film packages from Photography and Electrochem.
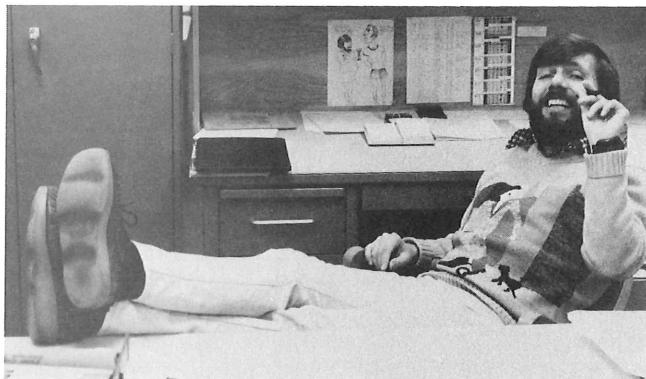
Howard Meehan attributes his youthful appearance to taking a few minutes out each day to improve the blood flow to his brain.

STATIC FREE VIALS AVAILABLE

Static free polyethylene vials for small static sensitive devices now have part numbers and have been ordered for stock. Prices on the vials vary from $0.12 to $0.26 each depending on size and quantity. 006-2416-00, 2/5 dram, 5/8" x 7/8" long vial; and 006-2418-00, 2 dram, 1/2" x

2-1/8" long vial are both now in stock. The following part numbers are on order and should be available by May 20.

006-2417-00	1½ dram	¾" x ¾" long
006-2419-00	4 dram	¾" x 2" long
006-2420-00	7 dram	1" x 2" long
006-2421-00	10 dram	1-1/8" x 2" long

For more information about availability and/or price, contact Glenn Johnson, ext. 7128.

Committee/Membership

Following is a list of people and work related committees to which they belong. It is hoped that this information will make it easier for Tek employees to address problems or comments to a specific group.

If you would like to make your membership on a committee more effective, fill in the following blanks and send the information to ENGINEERING NEWS at 50-462.

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NAME: _____

DEPT: _____

YOUR COMMITTEES: _____

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              RETURN TO: 50-462
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COMMITTEE MEMBERSHIP

John Trudel, FDI Marketing

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Please fill out & return to "Engineering News"

SPECIAL DESIGN FILE

Here are two more drawing packages which are available for the asking. Only two! Come on you guys. Someone is holding out. We've had a few calls from people who think this file is a really good idea and talk about how useful it is for them and how it will benefit the company. But when it comes time to send in descriptions and drawing packages of their designs, well, where are they? Probably upstairs in the Top of the Tek cafeteria buttering their English muffins. I know you're out there, I can hear you breathing.

If you would like a copy of either of these drawing packages, call Rhys, ext. 6071. Also, send in drawing packages and brief descriptions of any special designs that you would like to share to Special Design File, 50-462.

File No. 0016
HEAT TAPE TEMPERATURE CONTROLLER

   1. Provides device temperatures between 40°C and 70°C adjustable.

   2. Regulates temperature $< \pm.25°C$.

   3. May use any heat tape up to 400 watts.

   4. Over-temperature protection. —Gary Spence

File No. 0017
BCD INTERFACE FOR SYSTRON DONNER 7005 DVM

   1. Compatible with Tek-31-152 BCD Interface.

   2. Cable interconnections included. —Gary Spence

Scientific Computer Center

For the past several years the ANSI (X3J3) Fortran Standards Committee has been thrashing out another revision of the Fortran Computing Language. The last ANSI Fortran Standard was published in 1966. The status of this most recent revision has been watched very closely by the ACM-SIGPLAN Ad Hoc Committee on Fortran Development. The April 1976 issue of "For-Ward," the Fortran Development Newsletter (available for your perusal in the SCC area, contact Roy Carlson, ext. 7668) said the following about X3J3:

X3J3 'FAVORABLY DISPOSED' TOWARD IF-THEN-ELSE CURRENT REVISION

In an unofficial action, the Fortran Standards Committee (X3J3) expressed its inclination in favor of a proposal to incorporate an IF-THEN-ELSE structure into the current revision of Standard Fortran. This was expressed by an informal vote during the X3J3 meeting at NBS Gaithersburg Md (March 31-April 2), and was no doubt influenced by public response at the Fortran Forum earlier in the week. A number of members of the committee felt concerned because of the "lateness of the hour," but the prevailing sentiment was that the importance of this feature warranted giving some extra consideration to its adoption. The proposal, which was presented by Walt Brainerd and is, of course, subject to further revision prior to its possible formal adoption, was essentially as given below. Public comment on this proposal is solicited, and should be directed to Lloyd W. Campbell, BRL-CSD Bldg 328, Aberdeen Proving Ground, MD 21005.

THE PROPOSAL

In my opinion, and the opinion of many with whom I have talked, there is one single feature that would greatly enhance the effectiveness of the FORTRAN language. That feature is the ability to conditionally execute a block of statements.

It is also my opinion that there is now a concensus regarding the syntax that is desired to implement this capability. This consensus did not exist as recently as one year ago. Hence, I believe it is important and appropriate that the committee consider the feature at this time.

With proper use of this feature, the GOTO statement seldom will be necessary. Perhaps FORTRAN will even qualify as a "higher-level language."

Proposal: Add block IF, ELSEIF, ELSE, and END IF statements.

Rationale: This feature will make programming in FORTRAN much easier, producing more reliable and more understandable programs. See the example at end of proposal. Implementation should be very easy; the feature is described so that programs using these statements can be transformed into programs that do not use the statements by the insertion of GOTO statements.

Though everyone knows how these statements should work, the description is a bit cumbersome. The syntactic restrictions involve correct nesting with other block IF statements and DO-loops. The concept of IF-level is introduced to describe these restrictions. In order to describe the transfer of control that occurs upon completion of a block of statements, the concept of an IF-block is introduced.

Block IF Statement

The block IF statement is used with the END IF statement and, optionally, the ELSEIF and ELSE statements to control the execution sequence.

The form of a block IF statement is:
    IF (e) THEN

Where e is a logical expression.

IF-level

The IF-level of a statement s is

$$n_1 - n_2$$

where n_1 is the number of block IF statements from the beginning of the program unit up to and including s, and n_2 is the number of END IF statements in the program unit preceding s.

The IF-level of every statement must be zero or positive. The IF-level of the END statement of each program unit must be zero. The IF-level of each block IF, ELSEIF, and ELSE statement must be positive.

The IF-level of a DO statement and its terminal statement must be the same. The IF-level of each statement in the range of a DO-loop must be greater than or equal to the IF-level of the DO statement. The IF-level of each block IF, ELSEIF, ELSE, and END IF statement in the range of a DO-loop must be greater than the IF-level of the DO statement.

After an ELSE statement, an END IF statement having the same IF-level must appear prior to the appearance of an ELSEIF statement having the same IF-level.

IF-blocks

An IF-block consists of all executable statements from and including the first statement after a block IF, ELSEIF, or ELSE statement to, but not including, the next ELSEIF, ELSE, or END IF statement having the same IF-level. An IF-block may contain arithmetic, logical, and block IF statements. An IF-block may be empty.

Execution of a Block IF Statement

Execution of a block IF statement causes evaluation of the expression e. If the value of e is true, normal execution sequence continues. If the value of e is false, control is transferred to the next ELSEIF, ELSE, or END IF statement that has the same IF-level.

Termination of execution of an IF-block

If execution of the last statement of an IF-block does not result in a transfer of control, control is transferred to the next END IF statement having the same IF-level as the first statement following the IF-block.

ELSEIF Statement

The form of an ELSEIF statement is:
    ELSE IF (e) THEN

where e is a logical expression.

Execution of an ELSEIF statement causes evaluation of the expression e. If the value of e is true, normal execution sequence continues. If the value of e is false, control is transferred to the next ELSEIF, ELSE, or END IF statement that has the same IF level.

ELSE Statement

The form of an ELSE statement is:
    ELSE

Execustion of an ELSE statement has no effect. Normal execution sequence continues.

Execution of an ELSE statement has no effect.

END IF Statement

The form of an END IF statement is:
    END IF

Execution of an END IF statement has no effect. Normal execution sequence continues.

Other Changes:

The statement following the logical expression in a logical IF may be any executable statement except a DO, block IF, ELSEIF, ELSE, END IF, END, or another logical IF statement.

The terminal statement of a DO-loop must not be an unconditional GO TO, assigned GO TO, arithmetic IF, block IF, ELSEIF, ELSE, END IF, RETURN, STOP, END, or another DO statement.

The IF-level of a DO statement and its terminal statement must be the same.

An ENTRY statement must not appear within the range of a DO-loop or within an IF-block in a subprogram.

EXAMPLES:

The following three sequences of statements are equivalent:

Sequence 1:
```
        IF (COLOR .NE. 'RED') GO TO 20
            CALL RED
            GO TO 50

20      IF (COLOR .NE. 'WHITE') GO TO 30
            CALL WHITE
            GO TO 50

30      IF (COLOR .NE. 'BLUE') GO TO 40
            CALL BLUE
            GO TO 50

40      CALL ERROR

50      CONTINUE
```

Sequence 2:
```
        IF (COLOR .EQ. 'RED')
            CALL RED

        ELSE IF (COLOR .EQ. 'WHITE')
            CALL WHITE

        ELSE IF (COLOR .EQ. 'BLUE')
            CALL BLUE

        ELSE
            CALL ERROR

        END IF
```

Sequence 3:
```
        IF (COLOR .EQ. 'RED')
            CALL RED
```

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```
ELSE
   IF (COLOR .EQ. 'WHITE')
   CALL WHITE

ELSE
   IF (COLOR ,EQ. 'BLUE')
   CALL BLUE

   ELSE
      CALL ERROR
   END IF
   END IF
END IF
```

Ill-Conditioning In FORTRAN Program

The following is adapted from an article that appeared recently in one of CDC's technical publications. It may be of particular interest to programmers now involved in converting production programs from one compiler and library to another. In some cases, as outlined below, over-sensitivity to compiler or math library changes may be indicative of bad programming practice, or the use of an improper computation algorithm. Procedures for detection and elimination of such over-sensitivites are described in this article:

The execution of a FORTRAN program is affected by a number of variables: the word-size of the machine on which the program runs, the code generated by the compiler, the presence or absence of rounding in the evaluation of arithmetic operations, the precision of the input data, the precision of storage of temporary results, the object-time routines employed, and any system-supplied data. If the output from the execution of a FORTRAN program undergoes large changes when small changes are made in any single one of these variables, the program is called ill-conditioned with respect to that variable changed. In the case of interest, a program will be proved ill-conditioned with respect to the mathematical routines if traps in both old and new versions of some math routines indicate an acceptable relative error (say about 1.E-13 for single-precision, 1.E-28 for double precision) when run against the binary produced by the compiler, but the output shows an appreciably bigger variation.

We list some methods for detecting and eliminating ill-conditioning in programs.

1. Ill-conditioning due to inaccurate representation of input and intermediate results. This will be noticed when the program runs against different sets of data which are nearly equal, producing output differing appreciably more than input differences. Such ill-conditioning may be eliminated by increasing the precision of the data being input, or the precision of intermediate results.

2. Ill-conditioning due to inaccurate computation of arithmetical results. This is most conveniently detected by compiling the program, once with the FTN option ROUND=+−*/ specified, and once without, then looking for differences in the program's output from execution. This type of ill-conditioning can arise in a variety of ways. One common way is the evaluation of a long sum of the same precision as each of its components, e.g., in the computation of inner products, variances. (The current FTN compiler inserts code inline for exponentiation with a constant fixed exponent between −16 and 16, and the multiplications are rounded or not according to the ROUND=* specification's appearance on the control card.) Another common way is in the subtraction of nearly equal quantities, whose difference scales some output data. This may be important in certain iterations where the iteration count is a function of the data. Ill-conditioning arising from inaccurate differences may be checked by casting relevant variables and operations into higher precision.

3. Ill-conditioning due to the library of mathematical routines in use during execution. If the random number generator is called, check that the same initial seed and multiplier are being used. If the random number generator is not called, then changes in output across executions with two different libraries are due in almost all cases to one of the other forms of ill-conditioning affecting computation using a mathematical routine. To determine which routine is affected, substitute new math routines for old routines, one by one, when executing repeated runs with the same data. When the affected routine is detected, determine the occurrence affected by the ill-conditioning by replacing occurrences of that function, one by one, with calls for the function in higher precision, during repeated executions with the same data. An example of ill-conditioning associated with the library of math routines is as follows. If a program calls for computation of cosine near pi/2 (or sine near pi), and the result is used to scale output quantities, the program may be ill-conditioned. The reason is that the function has a zero at the point, but the result of the function evaluated near the point may lose significance because of the great magnification of machine error there.

4. Classes of programs known to be ill-conditioned. Included here are the programs to invert matrices, solve systems of linear equations, extract roots of polynomials, etc. An adequate literature exists to enable the programs's user to draw conclusions on the degree of significance of his output, for most cases here. Certain techniques may be safer than others, even though the cost in execution time is higher. For example, the Crout reduction is preferred (for error control) to the Gauss-Seidel methods of detecting ill-conditioning in such programs include replacement by equivalent expressions, and forward error analyses.

We give some examples of FORTRAN sequences where ill-conditioning can occur.

Example 1. (Insufficient precision in a stored constant.)

```
    PRINT 10, (I—1, TAN(I—1)*3.1416/180.),I=1,90)
10 FORMAT(1H1,10X,*TANGENT FOR ANGLES 0 to 90
   DEGREES*//
   +11X,*ANGLE*,SX,*TANGENT*//(11X,13,7X,F10.4))
```

In this example, pi is given (as 3.1416) to insufficient accuracy, since TAN has a singularity at pi. The approximation of 3.141592654 lowers the relative error of the last output item by several orders of magnitude. Instead, write

```
    PRINT 10, (I—1,TAN((I—1)*3.141592654/180.),I=1,90)
```

Example 2. (Insufficient precision in temporaries.)

```
       REAL, SX,SXX,FCN
       SX=SXX=0.
       DO 10 I=1,100000
       X=FCN(I)
       SX=SX+X
10     SXX=SXX+X*X
       AB=SX/100000
       SD=SQRT(SXX/100000—AV**2)
       PRINT 20,SD
20     FORMAT(11X,E17.10)
```

This example of a sequence to compute standard deviations may be ill-conditioned from two causes. First, the accumulation of running totals in SX and SXX may allow machine error to build up to significant levels. Second, if the standard deviation SD is small compared to the mean AV, significant accuracy loss may occur in the evaluation of the expression SXX/1000000AV**2, which is then small in comparison to subtrahend and minuend. A better sequence is

```
       DOUBLE SX,SXX
       REAL FCN
       SX=SXX=0.
       DO 10 I=1,100000
       X=FCN(I)
       SX=SX+X
10     SXX=SXX+X*X
       AV=SX/100000
       SD=SQRT(SNGL(SXX/100000-DBLE(AV)**2))
       PRINT 20,SD
20     FORMAT(11X,E17.10)
```

Example 3. (Precision loss in arithmetic operations.)

```
       REAL MX,MY,VX,VY,MASS
       READ *,SPEED,APEX,MASS,NO
       DO 10 I=1,NO
       ANG=APEX*(RANF(0)*2.—1.)
       VX=.5*MASS*(SPEED*(1.—COS(ANG)))**2
       VY=.5*MASS*(SPEED*SIN(ANG))**2
       MX=MX+VX
10     MY=MY+VY
       PRINT *,MX,MY
```

For values of APEX less than 1.E—7 in absolute value, any precision of MX is completely lost. This occurs in the evaluation of the expression 1.—COS(ANG), since the small x, $\cos(x)=1.-x^2$. However, some equivalent expressions preserve precision. For instance:

```
       REAL MX,MY,VX,VY,MASS
       READ *,SPEED,APEX,MASS,NO
       DO 10 I=1,NO
       ANG=APEX*(RANF(0)*2.—1.)
       VX—.5*MASS*(SPEED*2.*SIN(ANG*.5)**2)**2
       VY=.5*MASS*(SPEED*SIN(ANG))**2
       MX=MX+VX
10     MY=MY+VY
       PRINT *,MX,MY
```

We thank CDC for permission to reprint this article.

Roy Carlson ext. 7668

CURVET on the CYBER 73

When you analyze a circuit with SPICE2 and access the transistor library for a particular device, do you ever wonder what sort of model is being developed? A program has been developed to investigate the DC parameters of BJTs or any other three-terminal device which can be placed in a SPICE2 input format. Suppose you had to know the DC characteristics of the 151-0190-00 (an NPN transistor with JEDEC number of 2N3904). First, create a file with the .SUBCKT (or .MODEL) description. (In this case a separate SPICE2 run was required to get this file.) Note figure 1. This file name is "EN". To request the appropriate programs, enter

—CURVET(F=EN)

```
 SUBCKT Q190 3 2 1
Q1 3 2 1 M190
 MODEL M190 NPN BF=238,IS=1.279E-14,RB=12,RC=80,RE= 3,
+VA=241,IK=.1099,C2=2.92,NE=1 399,TF=1.53E-10,CJE=5.9P,PE= 83,ME= 4
+CJC=2 11P PC= 5,MC= 5,EG=1.11 )
CJC0 2 3 1.6E-12
CJE0 2 1 1.05E-12
 ENDS Q190
```

Figure 1. Contents of file EN.

```
ENTER ANALYSIS TYPE(1,2)
     1) DC TRANSFER CURVES
     2) IC, IB VS VBE (BETA VS IC)
? 1

TYPE OF DEVICE?(NPN,PNP)
? NPN

IS THE DEVICE TO BE CURRENT OR VOLTAGE DRIVEN?(I,V)
? I

CURRENT STEP?
? 2U

INITIAL, FINAL CURRENTS
? 2U 8U

SWEPT VOLTAGE?
? 4.

DEFAULT LABEL ARE 'IC','VCE','IB'—OK?(Y,N)
? Y

 ENTER TITLE FOR PLOT
? 151-0190-00 CHARACTERISTICS
```

Figure 2. Dialog for DC Transfer Curves.

Figure 2 shows the subsequent dialog. After the preliminary questions are answered, a sequence of SPICE2 jobs are run to determine IC vs VCE for the specified IBs. Figure 3 is a copy of the generated output.
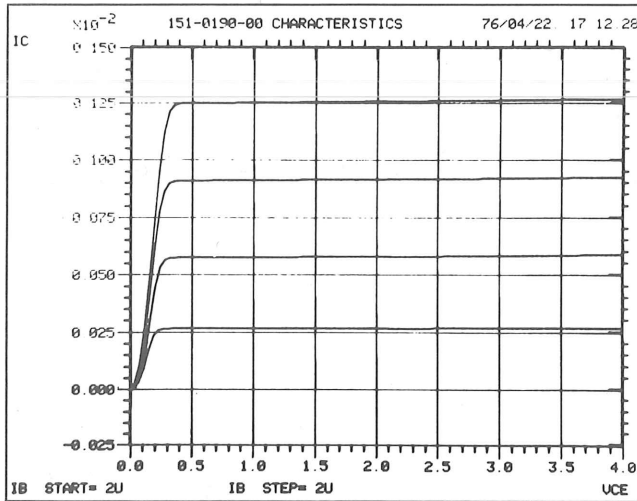

Figure 3. DC Transfer Curves for 2N3904.

Now suppose you need the IC and IB vs VBE characteristics. The programs are again initiated and the ensuing dialog is shown in Figure 4. This time only one SPICE2 job is gene-

```
ENTER ANALYSIS TYPE(1,2)
     1) DC TRANSFER CURVES
     2) IC, IB VS VBE (BETA VS IC)
? 2

TYPE OF DEVICE?(NPN,PNP)
? NPN

DEFAULT VBE SWEEP IS .2V TO .8V--OK?(Y,N)
? Y

DEFAULT VCB IS ZERO (0)--OK?(Y,N)
? Y

ENTER TITLE FOR PLOT
? 151-0190-00 CHARACTERISTICS
```

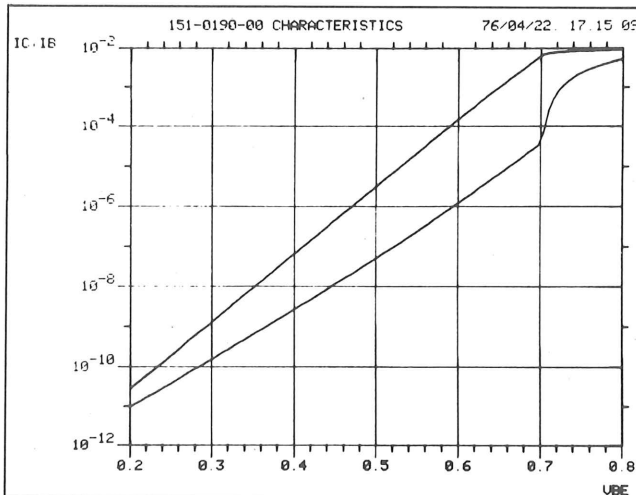Figure 4. Dialog for IC and IB vs VBE Curves.

Figure 5. IC and IB Curves for RC=80 ohms.

rated as VBE is swept only once. The corresponding outputs are shown in Figure 5 and Figure 6. The relationship of IB to VBE at the higher currents might cause you to think that the device is acting strange. Not so. Figure 1 shows that RC is 80 ohms. This forces the device to saturate, causing the
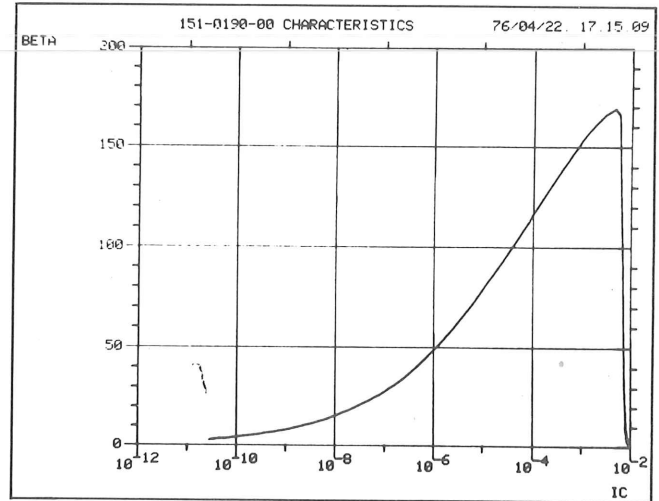

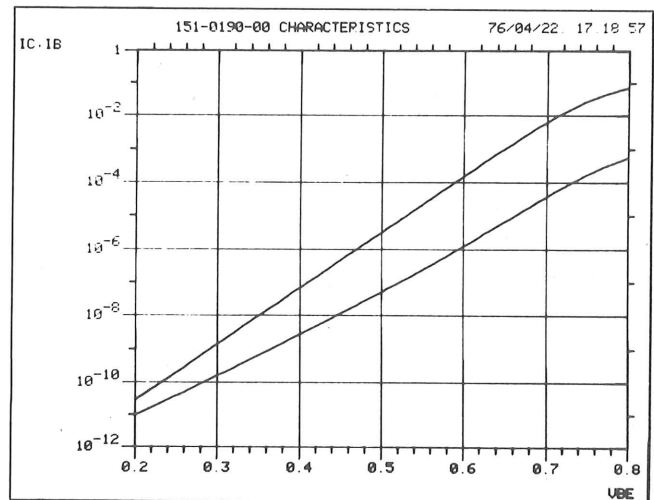Figure 6. BETA vs IC for RC=80 ohms.
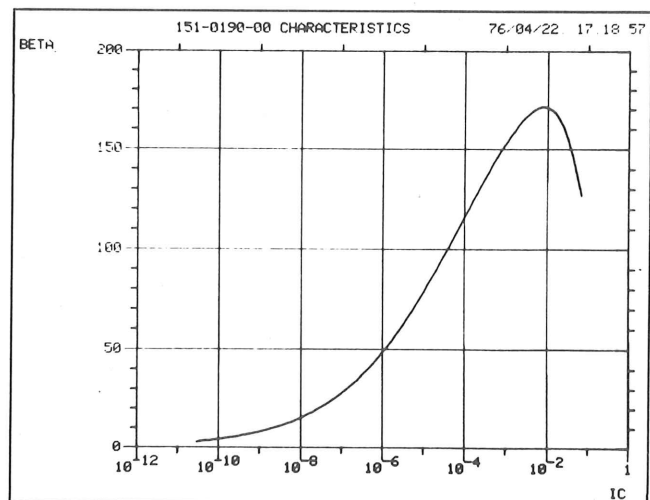

Figure 7. IC and IB Curves for RC=0 ohms.

Figure 8. BETA vs IC for RC=0 ohms.

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phenomenon. As a check, RC was set to zero and the analysis was repeated. Figures 7 and 8 show the results. Note that these relationships appear to be closer to the expected values.

Any three-terminal device can be characterized. Built-in SPICE2 models can be experimented with. User-defined subcircuits can be characterized. Four-terminal devices can be characterized if one of the nodes (usually the bulk or substrate node) is tied to a power supply or ground which is internal to the subcircuit. For additional help, type HELP, CURVET or call Ron Bohlman, ext. 5866.

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papers...Call for papers...Call for papers

The 1976 Ultrasonic Symposium will be held on September 29 to October 1, 1976 at the Annapolis Hilton Inn, Annapolis, Maryland.

SPONSOR: IEEE Group on Sonics and Ultrasonics

TOPICS: The subject areas have been classified into the following headings:
   Acoustical Imaging and Holography
   Medical: Clinical Applications and Biophysics
   Physical Acoustics: Basic Properties
   Acousto-Optic and Acousto-Electric Devices and Applications
   Bulk Wave Devices: Oscillators, Filters, Resonators, Transducers, Delay Lines
   Surface Wave Transducers and Filters
   Surface Wave Materials and Fabrication
   Surface Wave Oscillators
   Surface Wave Resonators
   Surface Wave Signal Processing and Transform Devices
   Surface Wave Propagation, Waveguides and Delay Lines
   Industrial Applications and Industrial Noise Generation
   Nondestructive Testing: Techniques and Devices
   Other

ABSTRACTS: Submit the original and 16 copies to the Chairman of the Technical Program by June 24, 1976. The instructions for abstract preparation are fairly detailed. If you are interested in this symposium, copies of the complete Call for Papers notice are available in the Technical Information Office, 50-462.

The IEEE—1977 International Semiconductor Power Converter Conference will be held at the Walt Disney Contemporary Hotel in Orlando, Florida on March 28-31, 1977.

SPONSOR: Static Power Converter and Power Semiconductor Committees of the Industry Applications Society.

TOPICS: Papers are solicited in three major areas:
   1.   Solid State Power Converter Equipment and Systems. New and improved systems for use in industry, utility, transportation, aerospace, and related applications.
   2.   Control Methods and Concepts for Semiconductor Power Converters.
   3.   Power Semiconductor Devices.

DRAFTS: Submit three copies of a draft of the proposed paper to the Papers chairman by June 4, 1976. The draft should be about the same length as the final paper. Acceptance notifications will be sent by July 1, 1976.

OTHER: General Conference Chairman:
   Eberhart Reimers
   USAMERDC, AMXFB-EA
   Electrical Equipment Division
   Fort Belvoir, VA 22060
   Phone: (703) 664-5596

   Technical Program Chairman:
   Richard G. Hoft
   Electrical Engineering
   University of Missouri-Columbia
   Columbia, MO 65201
   Phone: (314) 882-3491

The 1977 Joint Automatic Control Conference will be held at the Hyatt Regency Hotel in San Francisco, June 22-24, 1977. The theme of the conference is "Control Theory and Applications in the Service of Local Industry."

TOPICS: Areas of interest include:
   System Modeling and Identification
   Decision and Control
   Pattern Recognition and Linguistic
   Methods applied to Large Scale Systems
   Health Care and Bioengineering Systems
   Microprocessors for Control

ABSTRACTS: Submit transaction-quality papers by November 1, 1976 to:
   Steve Kahne, Editor

→

Department of Electrical Engineering
University of Minnesota
Minneapolis, Minnesota 55455

In addition, send the title, author's name, address, and the abstract to:
Dr. Alex Levis
Assistant Program Chairman
Systems Control Inc.
1801 Page Mill Road
Palo Alto, CA 94304

Authors will be notified of acceptance shortly after February 1, 1977.

The 1977 IEEE International Conference on Acoustics, Speech and Signal Processing will be held at the Sheraton--Hartford Hotel, Hartford, Connecticut on May 9-11, 1977.

SPONSOR: IEEE Acoustics Speech and Signal Processing Society

TOPICS: The conference will be devoted to the following areas:
Signal Processing & Speech Processing
Underwater Acoustics
Electroacoustics
Noise Measurement

ABSTRACTS: A Title and 100-word Abstract on one plain 8½ x 11 paper should be submitted in triplicate (one copy must be the original). They are due by October 15, 1976. Authors kits will be sent out by December 15, 1976.

OTHER: Submit abstracts to:
Dr. N. Rex Dixon
Technical Program Chairman
IBM—T.J. Watson Research Center
P. O. Box 218
Yorktown Heights, N.Y. 10598

The 1976 International IEEE/AP-S Symposium and USNC (U.S. National Committee)/URSI (International Union of Radio Science) Meeting will be held jointly at the University of Massachusetts, Amherst Campus, on October 10-15, 1976.

SPONSOR: IEEE Antennas and Propagation Society and USNC/URSI

TOPICS: Suggested topics for AP-S:
Multibeam and limited-scan antennas
Adaptive antennas
Electrically small antennas
Antenna measurements and near field techniques
Reflection and high-gain antennas

Computer-aided antenna design
Electromagnetic theory
Wave propagation
EM application to biology, environment and transportation

Suggested topics for URSI:
Electromagnetic Metrology
Fields and Waves
Signals and Systems
Mutt and Jeff
Physical Electronics
Interference Environment
Wave Phenomena in non-ionized media
Inospheric Radio
Waves in Plasmas
Radio Astronomy

ABSTRACT: All summaries for AP-S and abstracts for URSI must be received by July 1, 1976.

OTHER: Submit papers to:
R. L. Fante
AFCRL (LZ)
Hanscom AFB
Massachusetts 01731

EUROCON '77 will be held in Venice on May 3-6, 1977.

SPONSOR: IEEE Region 8 and EUREL (The Convention of National Societies of Electrical Engineers of Western Europe)

TOPICS: Areas of interest include:
Communications in large electrical power systems
New developments in communications
Communications and computers
Communications and signal processing in medicine
Communication problems in developing countries

ABSTRACTS: A 300-500 word abstract must arrive by June 1, 1976. Submit abstracts to:
EUROCON '77
c/o AEI-Viale Monza
259-20126
Milano (Italy)

OTHER: For further information, write to the above address.

The 1976 Biennial Display Conference will be held at the Statler Hilton Hotel, Seventh Avenue and 33rd Street, New York, New York on October 13-15, 1976.

SPONSOR: Electron Devices Group of the IEEE, the Society for Information Display, and the Advisory Group on Electron Devices →

TOPICS: Areas of interest include but are not limited to:

Light emitters
Non-emissive technology
Direct view
Projection
Addressing Technology
Device reliability
Display characterization
Phosphors
Fiber Optics
Electron Optics
Photochromics
Cathodochromics

Recording and Stroage media for displays
New phenomena, concepts, and applications
Interactions between device performance, system requirements, and economic considerations

ABSTRACTS: Twenty copies of both a 35-word abstract and a one-to-two-page draft summary are due by June 7, 1976. The instructions for preparation of abstracts and papers are detailed. If you are interested in the Display Conference, copies of the complete Call for Papers notice are available in the Technical Information office, 50-462.

Fiber Optics Workshop

The San Diego State University Department of Electrical Engineering and the Navy Electronics Laboratory Center will present an **Applied Fiber Optics Workshop** June 1-4, 1976. The course will be addressed to communication engineers, planners and users, system scientists and project managers. Topics will include:

Introduction and Market Analyses
Single Fibers, Multiple Fiber Bundles/Cables
Connectors, Couplers, Interfaces
Sources
Detectors
Transmitter Design
Receiver Design
Components Measurements Laboratory
System Design
System Measurements Laboratory
Radiation Effects

In the afternoon sessions the participants will make optical measurements, mechanical tests and practice connector termination techniques. For further information on this workshop contact:

Conferences and Professional Programs
Office of Continuing Education
San Diego State University
San Diego, California 92182
or call (714) 286-5978.

TECHNICAL STANDARD MOVES

Technical Standards has moved from Building 39 to Building 58. Their new delivery station is 58-187. The people in Technical Standards are Chuck Sullivan, Dwain Hall, Pauline Whitmore, Gene Palmer, and Carol Schober.

New Coating for Coils and Toroids

A UV-curable coating for coils and toroids has reached the final stage of engineering evaluation.

In the past, a heat-curing resin (Lonco solder resist) has been used to hold the wires in place on these components and to provide a smooth surface for part numbering.

The new resin offers the following advantages:

1. A high-speed cure that requires a fraction of a second exposure to a mercury lamp (ultra violet radiation).

2. Solventless—Present system uses undersirable toluene solvent-cure system.

3. Ease of application—Substantially reduced labor.

4. No measureable effect upon electrical parameters.

5. Process speeds limited only by the mode of application.

Several thousand production parts have been tested and followed through production with no difficulties. This is the result of a team effort involving production people in Ross Kines' area (Coil Mfg.-SPECs), Tom Morisky, Loren Spohm, and Cary Haag of ECM Production Engineering.

If any difficulties with this method of manufactur are suspected by users of any coils or toroids, please contact Cary Haag, 288 Sunset, or Tom Morisky at 7449.