VOL. 2 NMBR. 1 / JAN 1975 / TEK USE ONLY

ENGINEERING NEWS

JOYCE LEKAS, EDITOR / DEL. STA. 50-423 / X6601

ION IMPLANTATION NOW IN ICE

by Rhys Schrock

For the past 21 months, the IC Engineering group at Tektronix has been experimenting with ion implantation as a possible alternate method of producing bipolar and metal-oxide semiconductor (MOS) devices. Ion implantation in these applications consists primarily of using an accelerator and separating magnet to introduce specific foreign atoms into a prepared semiconductor wafer. A basic objective is to control quantity and placement of the ions to produce predictable electrical properties in the semiconductor, although mechanical, optical, magnetic, and superconducting properties are also affected. As surface dimensions of devices become smaller, a shallower presence of dopant atoms is desired. Right now, the heaviest use of ion implantation outside Tek is in MOS IC fabrication, where the ability to introduce light ion doses is considered to be a great advantage.

OUR PRESENT SEMICONDUCTOR PRODUCTION

A standard process sequence for manufacture of semiconductors consists of several masking and etching steps to define functional features. These steps are alternated with one or more diffusion steps in which selected areas are doped at a predetermined concentration with boron, phosphorous, or arsenic in a diffusion furnace.

ION IMPLANTATION AS SUBSTITUTE FOR DIFFUSION

Elements of IIB, IIIA, VA, and VIA periods, commonly boron and arsenic, are piped into an ionizer and ions are drawn into an accelerator by induction of a voltage drop. The ions are accelerated to 20-200 keV and passed through a magnetic field which bends them towards a target. The selected ions are passed through sweeping plates which aim them at the target, in this case a semiconductor wafer prepared through masking and etching for the introduction of dopant.

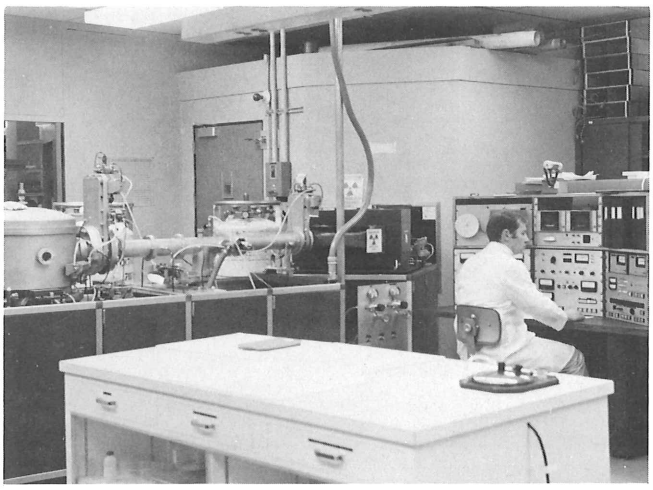

Figure 1. The accelerator at TEK. From left to right; vacuum chamber; tube with focusing points and sweeping plates; separating magnet; lead lined room which contains ion source and accelerator column; Gorden Roper at the console panel.

Depth of the implanted ions at the uniform energy level is shown in Figure 2 as a Gaussian profile. Depth is controlled primarily by the energy of the ion beam.

Depth can also be controlled by alignment of the substrate crystal structure with the ion path, this called the channeling effect see Figure 3. Note the direction of the ions entering the lattice system along the widest opening possible in the crystal structure. Improper alignment does not permit such unimpeded travel by the ions. This factor is often utilized in shallow implantation.

Notice the occurrence of lattice disorder shown in Figure 4. Lattice disorder is the displacement of crystal atoms by the colliding dopant ions as they lose speed. Heavy doses of ions can cause wider incidence of lattice disorder to create an amorphous area where individual damage regions overlap.

THE TEKTRONIX ACCELERATOR

The equipment consists of an ionizer in a lead steel shielded room, an accelerator, a separating magnet, a series of focusing points, sweeping plates, and a vacuum chamber in which the wafers are placed. Figure 5.

Three types of ion sources are used. The most common is a RF discharge tube; a glass envelope with two RF clips on the tube and an electrode at each end. The RF clips generate up to 100 watts of RF power at a frequency of 100MHz. Phosphorous, boron, oxygen, nitrogen, helium, and hydrogen are ionized this way. A cold cathode, using an arc discharge system is also common for ionization of arsenic. The filaments in a hot cathode create an electron source for ionization of elements not normally found in a gaseous state such as manganese and other metals.

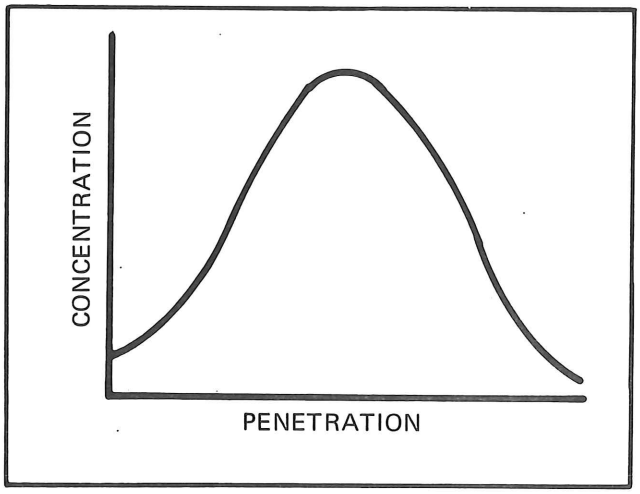

Figure 2. Depth of implanted ions at a uniform energy level.

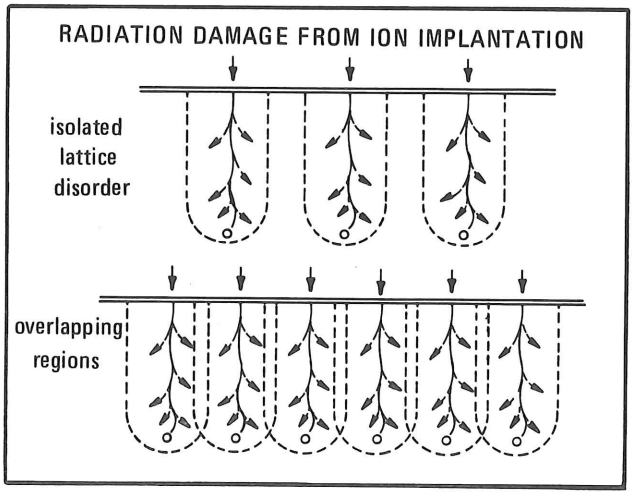

Figure 4. Lattice disorder. Heavy doses of ions may cause areas to overlap, forming amorphous regions.

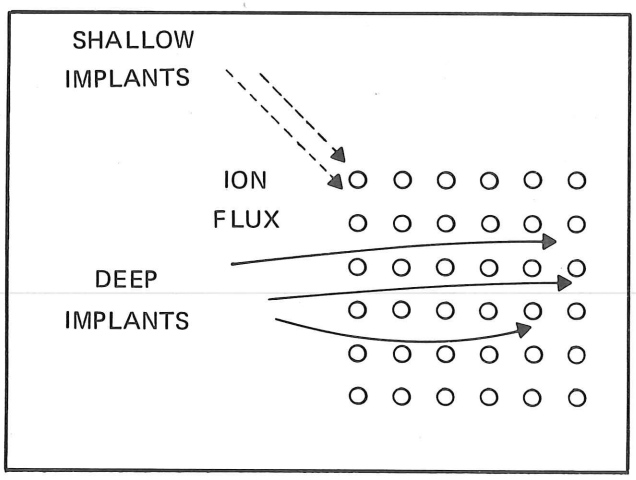

Figure 3. The channeling effect is controlled by alignment of the substrate crystal structure with the ion beam.

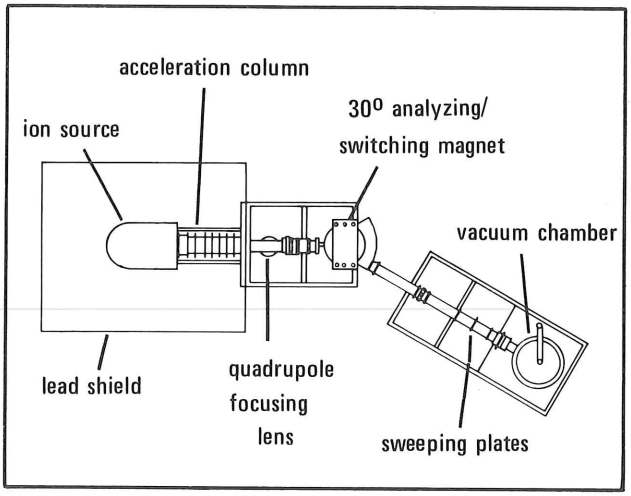

Figure 5. The accelerator equipment necessary for ion implantation.

A voltage drop is induced between the two ends of the ionizer to draw the ions into the accelerator, a glass tube with twelve metal electrodes mounted evenly along its length. A voltage drop of 1.5-20KV between each of these electrodes is controlled from the console These voltages relate directly to single ion keV.

After realignment through a focusing lens, the ions pass through a powerful magnet. Here the desired ion is bent towards its final target, and unwanted species are separated by mass selection.

The object ions then pass through vertical and horizontal sweeping plates, similar to those found in a CRT. The ion beam is re-focused and swept uniformly across the wafer surface. The vertical and horizontal sweeping plates are intentionally out of synchronization to avoid forming definite trace patterns across the prepared wafer surface. The wafer is a two inch silicon disk with devices on the order of .100 inch etched on the surface, Figure 6. The wafers are mounted on a carousel, Figure 7, 30 at a time, and loaded in the vacuum chamber which is pumped to 10^{-6} torr. The process can continue automatically through two carousels (60 wafers).

Ion Implantation is substituted for diffusion in the normal process sequence for production of a semiconductor. The prepared silicon wafer is carefully cleaned , mounted in the carousel, and loaded into the vacuum chamber. The wafer crystal structure is normally aligned directly with the ion beam for deep implants, but the wafers can be loaded into a special carousel which tilts them at a 7° angle to avoid deep channeling in shallower implants. Once the implant cycle is run a second cleaning is performed. The final step is annealing. The wafers are placed in a high temperature furnace with a dry nitrogen or argon gas flow at 900-1100° C. This fixes the dopant ions in their proper substitutional sites, corrects lattice disorder, and restores electrical activity to the implanted regions.

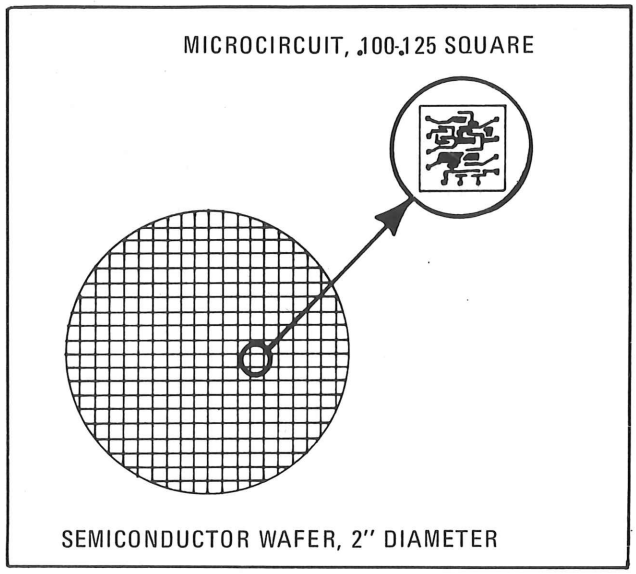

Figure 6. A semiconductor wafer containing hundreds of microcircuits.

PROGRESS SO FAR

The experimental group at Tek spent the first year accumulating background material in standard ion implantation procedure, familiarizing themselves with the new equipment, and making necessary modifications in the accelerator.

Over the past several months ion implantation has been applied to bipolar transistor discrete devices, bipolar IC's and field effect transistors. It is hoped that usable circuits will be available within the next few months.

There has also been some experimentation with MOS IC's. MOS devices require shallow implants of dopant to control threshold levels. Here is where ion implantation will be of high value because of the precision and controllability of the process.

Other projects under consideration but still termed "low-level" are proton enhanced diffusion in which a beam of protons (hydrogen or helium ions) is used to promote the diffusion of phosphorous or boron into the sample surface; and pattern isolation, where H+ bombardment is used to create radiation damage in the silicon substrate, forming dielectrically isolated regions.

Computer programs have been used to simulate the implantation process. Although there has been some discrepancy between the simulated and actual results with the lighter ions, results with the heavier ions (arsenic and phosphorous) are close to the simulated programs.

As computer simulation develops and the processes are adjusted and refined standards should evolve to aide in the design of Bipolar and MOS devices produced by the Ion Implantation process.

Further information can be obtained by contacting Dean Casey at Ext. 5370.

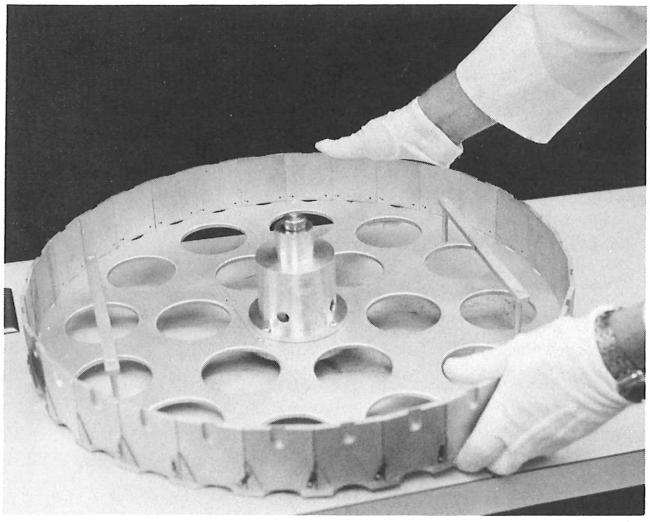

Figure 7. This carousel holds 30 semiconductor wafers. Two such carousels can be loaded into the vacuum chamber and run automatically.

MSEE CLASS WORK FOR WINTER TERM

At this time there are three M.S. programs from three institutions offering classes to qualified Tek engineers at or near Tek.

O.S.U. Courses (at Tek)

EE538 "Analytic Techniques in Fields and Waves" Dave Morton, Tektronix
EE523 "Switching and Automata", Rick Adrion, O.S.U.
EE561 "Communication Systems", Mark Ballan, O.S.U.
EE550 "Introduction to Systems Theory", Jim Blight, Tektronix

U.P. Courses (at Tek)

EGR504 "Introduction to Systems Theory", Jim Blight, Tektronix (Same Course as EE550 – cross listed by both institutions).
EE511* "Solid State Electronics", Tom Nelson, U.P.

Oregon Graduate Center (at O.G.C.)

"Electric and Magnetic Fields", McIntyre
"Quantum Mechanics" (2nd Qtr.), Barofsky
"Statistical Mechanics", Throop
"Quantum Electronics & Modern Optics", (2nd Qtr.), Massey
"Mathematical Physics" (2nd Qtr.), Elliot

*EE511 will be offered at Tektronix on Mondays and Wednesdays from 6:00 to 7:30 p.m. in the building 15 cafeteria (the classroom in the corner). It can be taken for graduate or undergraduate credit, or on an incidental basis. The course offers an introduction to the physics of solid state devices. A prior course in materials science is desirable but not a prerequisite. Calculus including some differential equations is necessary.

Textbook: Ben G. Streetman, **Solid State Electronic Devices**

Outline:

Introduction to quantum mechanics	1 week
Energy bands and charge carriers in semiconductors	4 weeks
PN junction theory and devices	3 weeks
Theory of the bipolar junction transistor	3 weeks
Theory of FETs, with emphasis on MOS	2 weeks
Miscellaneous devices	1 week

For further information on any of these courses, call Harley Perkins ext. 6186, delivery station 50/475 Jim Sayer ext, 5496, delivery station 74/434

Portland State University (P.S.U.)

ASE410 "Fundamentals of Engineering Analysis", John Hummer, P.S.U.

Although this course is not for graduate credit or any degree program above, it does address the need of the professional engineer who has been out of school for some time and is planning to enter or reenter graduate school. It may also fill the needs of those who are experiencing difficulties with analytical concepts and techniques.

"Surface Physics", Lynn Swanson, O.G.C.

Students in the O.G.C. can take this course at P.S.U. and get credit at O.G.C. Contact Dr. Swanson at O.G.C. if interested.

IN PRINT...

Val Garuts, High Frequency Lab Scopes, and **Mike Boer,** Design Engineer, collaborated on an article in the October 21 issue of Electronic Products Magazine. The article, entitled *A State of the Art Instrument – The High Frequency Scope,* describes various oscilloscope operations, application, and limitations. A section is included on selecting the proper high frequency probe.

Ian Getreu, Integrated Circuit Engineering has published the second and third in his series of three articles on *Modeling The Bipolar Junction Transistor* in the October 31 and November 14 issues of Electronics. These two articles discuss the theoretical aspects of the second level Ebers-Moll model (Oct. 31) and measurement of the model parameters for that model (Nov. 14).

Jim Gerakos, Industrial Designer, authored an article entitled *Building A Medical Monitor* in the November issue of the IEEE spectrum. This article traces the development of the Tektronix 410 Physiological Monitor from initial conception to product completion, with emphasis on the team effort principle of product design.

Dr. Jere M. Marrs, Analytical Instruments Marketing, recently wrote an article in the November issue of Research and Development Magazine called *RAPID Color Measure-*

continued on next page

IN PRINT...

ment. Use of the Tektronix 7020 RAPID-SCAN Spectrometer for quickly determining the fundamentals of spectral radiant power is discussed. In addition to various specific system applications, several diagrams and oscilloscope photographs are included.

Steve Rosenthal, Advertising, wrote an article which appeared in the November 22 issue of Electronic Design Magazine entitled *Choose the Right Storage Oscilloscope.* The article explains basic principle of storage oscilloscope operation, and details various applications. In addition, a comparison is made among the major storage techniques available instruments.

Morris Engelson, Spectrum Analyzer Engineering, wrote an article called *Understand Resolution for Better Spectrum Analysis* in the December issue of Microwaves Magazine. The article is a fairly comprehensive user's guide to better measurement resolution. The article is illustrated with many oscilloscope photographs.

EPA lifts standards

Proposed U.S. Environmental Protection Agency standards, originally expected to go into effect by the middle of 1975, would insure tighter control over the limits of air pollution allowable in the manufacture of glass fiber used in printed circuit boards. Expectation of these standards has forced the fiberglass industry to begin developing an alternative for the present "E" type glass, with less than satisfactory results so far. One new formulation, called E-3709, has various physical properties which vary markedly from those of the industry-standard "E" glass. The eventual effect of this on pc-board users remains a question.

Recently, however, the EPA reversed its decision towards the tighter environmental standards. The latest policy apparently resulted from a conflict between the EPA and the U.S. Dept. of Defense regarding the quality of fiberglass material, related to established military specifications for pc-board construction.

While actually only an indefinite extension of time, the reversal does provide the industry with more development time, and temporarily insures the quality of circuit board material that TEKTRONIX purchases.

Patent Pursuit Promoted

In this dynamic age of mushrooming technology, the role that a patent plays is becoming increasingly important to anyone who brings a product to the marketplace, and those who are "patent conscious" gain the competitive edge. Companies are now actively pursuing patent protection for contributions which were once considered unpatentable, because the alert businessman realizes that even an improvement over the existing art gives him some bargaining leverage. This could lead to negotiating a cross-licensing agreement, or the direct marketing of his product, even though it infringes on an existing patent.

At Tektronix, we live at the edge of the state of the art, and as a manufacturer of scientific instruments, we need to be "patent conscious". Every new product introduced can potentially infringe on other patents, and the letters that arrive requesting royalty payments amply support this fact.

Five years ago, it was decided to create an in-house patent operation to provide Tektronix with better patent protection, at a fraction of the cost charged by an outside law firm. This also allowed for better communication between engineers and the patent department. All Tektronix patents are now obtained and filed by John LaRue, the company's only patent attorney. His staff consists of Tom Noe, a registered patent agent, and Ken Durk, scheduled for a patent examination later in 1975. Both Tom and Ken also have engineering backgrounds.

To obtain a patent, the inventor would first disclose his information to the patent department, preferably using an invention disclosure form available for this purpose. The merits of the invention are then discussed by the company's patent committee. Usually a patentability search is conducted to determine where an idea stands, with regard to the existing art. If the invention appears to be feasible to patent, an application is made at this time.

The Tektronix patent department has copies of all company patents on file, plus many related patents, all available for engineering use. Copies of patents held by other companies or individuals can also be quickly obtained. For additional information, or answers to any questions, call John LaRue, ext. 5266, Tom Noe, ext. 5290, or Ken Durk, ext. 5403.

the LATEST from the LIBRARY

The library has recently acquired two major computer-produced bibliographies: one on SECONDARY ELECTRON EMISSION, the other on CHARGE COUPLED DEVICES. The originals of these bibliographies covering 1969 through 1974 are still available also. For copies of these and literature searches on other topics, call Julie at ext. 5388.

Scientific Computer Center

When the CYBER 73 is winning, call for help

Having computer power available, and being able to use it effectively is not always the same thing. Now that the Scientific Computer Center's CYBER 73 system is working, let's review some guidelines for when you're sitting at a terminal and need assistance.

When initially logging on to the TEK CYBER 73 system, learn of any recent changes in programming or system operation by calling NEWS on your terminal. This information is dated, and will often provide advance answers to questions or problems you will encounter later.

If it is a programming question, the best source of immediate information is the appropriate documentation. Included in the group is the 'Kronos 2.1 Reference Manual', the 'Time Sharing User's Manual', and the relevant programming language manual, (i.e. Fortran). Assuming a solution isn't found, call ext. 7446 and ask for programming assistance.

If a non-programming problem is encountered while running, (i.e. what is the load on the system?), there are two procedures to follow. The first is to utilize the system's SAMTOP, (Send a Message to Operator), feature. Entering SAMTOP into your terminal will bring a personal response from the operator, via your screen. Please be patient. The operator will reply as soon as possible. The alternative solution is to telephone directly for assistance, ext. 5104.

When an actual system malfunction is suspected, obtain and complete a 'CYBER 73 Problem Report' form and send it to the center.

At this time, or anytime, you might also want to inform LUCY of your problem. LUCY is a humanitarian feature of the TEK CYBER 73 system, allowing the user to ask questions, state viewpoints, or simply look for sympathetic understanding. All LUCY inquiries will be responded to in group fashion, via the terminal, probably on the day following the original entry, and items of interest may periodically be printed in ENGINEERING NEWS. Remember, LUCY gladly accepts praise!

Considerable effort has been made to minimize system problems and inconveniences for the user. For further information on the TEK CYBER 73 system, contact Roy Carlson or John Telford, ext. 7668.

FFT Added to SSP

A One-dimensional Finite Complex Fast Fourier Transform Routine has been added to the scientific subroutine package. A few people have tried it, and it seems to be working OK so far.

The routine contains documentation in its source listing.

To list out routine:

GET, SSPS/UN=LIBRARY

This gets the source file for all the scientific subroutines. Now, the Text Editor can be used to find the Text String:

'SUBROUTINE FFT'

The documentation follows this heading (about 60 lines). If you have any questions, call Imants at 5127 or 7446.

Interactive Statistics Package

ISIS, an interactive statistics package, is now available on Tek's timeshare system.

ISIS consists of nine data preparation programs and sixteen statistical analysis programs.

The statistical analysis programs include multiple regression, partial correlations, polynomial regression and univariate data descriptive statistics.

To obtain a copy of the ISIS manual in the form of a computer printout, type (on a terminal connected to the CYBER 73 not your typewriter.)

GET,ISISMAN/UN=ABØØIGA
DISPOSE, ISISMAN=PR

continued on next page

SCC continued

The printout can be picked up in the computer room (4th floor, Bldg. 50).

To run ISIS, simply type:

–ISIS

If you have any questions or problems, contact Imants Golts X5127, 50-462.

Project Numbers

Master users no longer can set up or delete project numbers. The reason is that project numbers must be corporate project numbers for cost transferring. At the end of the period there is not enough time to run verifications and corrections on all project numbers. To set up new project numbers, please call extension 5104 and any operator will do it for you.

Tom Bohan

CYBER 73

TEK Runtime	M,W,F	0700 to 2100 Hours
TEK Runtime	T,TH	0800 to 2100 Hours
Maintenance Hours	T,TH	0400 to 0800 Hours
Systems Time	M,T,W,TH,F	2100 to 2400 Hours
TEK Runtime (FREE)	SAT	0900 to 1700 Hours

Systems time is only if needed, otherwise Time Sharing will be up till 2400 hours.

Any questions please contact Tom Bohan at ext. 7446, or Bob Mainero at ext. 5104.

Tek H-P Interface Faceoff

If you are a digital interface fan, you may recall that in an earlier issue of ENGINEERING NEWS it was predicted that the "move toward a standard interface will snowball. . . . ". If you follow the literature[1], you know that it was, largely due to the efforts of H-P. The work we've done at Tektronix is not publicized, but it is just as significant. The purpose of this article is to let you know where we've been, where we are, and where we're going with the General Purpose Interface Bus (IEC Interface, GPIB, HPIB, etc.).

The GPIB has been kicking around Tektronix for over a year and a half. The first serious work concerned the development of a 7000 Series mainframe for programmable plug-ins. The conflicts that arose with the mainframe caused Bill Walker to establish an Interface Standards Committee to study and resolve all future conflicts. This committee is chaired by Bruce Hamilton and has been meeting for about a year. In addition to the committee within Tek, we are represented in the IEC Advisory Committee on Computer/Instrument Interfaces by George Rhine of Calculator Engineering.

The Interface Standards Committee has the authority to establish hardware and software interface standards for all digitally interfaced Tektronix instruments. The committee reports directly to Bill Walker and thus serves all engineering groups. The present philosophy is that all programmable instruments will have a GPIB interface, and that this interface must meet the standards set by the committee or have committee approval for exceptions.

The committee has established and documented several standards that are available on request[2]. They are:

"Standard Interface Systems for Programmable Measuring Apparatus" (IEC)
"IEC Interface Language Format for Tektronix Measurement Apparatus"
"Interface for 7000 Series Programmable Plug-ins"

In addition to these documents, a mnemonic library file has been established on the KRONOS system and a sub-committee is working on a low-level language proposal. It should be noted that Tektronix appears to be the only company that has done any work on a software or language standard.

The standards have been set. We wait now for operational hardware to prove their reliability. There are presently at least 15 programmable instruments including two intelligent controllers in various stages of development at Tek. One of these is a 7000 Series programmable mainframe which will be used with all programmable plug-ins. Several of the instruments will be using various micro- processors as the basic logic element. Ergo, we will shortly have considerable expertise in IEC implementation.

The GPIB is snowballing at Tek. We have standards. We have hardware. We have a growing body of expertise. The members of the Tek Interface Standards Committee are all available to help in any way possible with your new designs. Call us.

continued on next page

[1] See bibliography. Copies available from library.
[2] Copies available from Pauline Whitmore X7976

Tek H-P Interface Faceoff

BIBLIOGRAPHY OF RECENT ARTICLES

Interface Bus Makes ATE a Reality for Bench Users," MSN: October/November 1974.

"How to Build an Automated System around a Programmable Calculator" P. David Fisher and Stephen M. Welch, ELECTRONICS, May 16, 1974, pp. 104-109.

"Standard Instrument Interface Simplifies System," ELECTRONICS, November 14, 1974, pp 95-106.

"What Makes a Good Interface?", IEEE SPECTRUM, November, 1974, pp 52-57.

"Calculator Governs Data Acquisition," DIGITAL DESIGN, November 1974, p21.

"Uniform Interface Bus Developed for Instruments," ELECTRONIC PRODUCTS, November 18, 1974, pp. 93-95.

"Team Calculators with Instruments, Roger Youngberg, ELECTRONIC DESIGN, November 22, 1974, pp 176-179.

"Instruments 74 — Programmable Instruments", Dave Kaye, ELECTRONIC DESIGN, November 22, 1974, pp. 74-79.

"International Electrotechnical Commission Digital Interface," TEKTRONIX ENGINEERING NEWS, Volume 1, Number 1, p. 4.

TEKTRONIX IEC COMMITTEE

Bruce Hamilton, Chairman	Dig. Meas. Products	6878
Wayne Eshelman	Dig. Meas. Products	7173
Val Garuts	H.F. Lab Scopes	6277
Jim Geddes	TM 500	6562
Roger Handy	IDD Software	261S
Gary Hoselton	Automated Systems	7034
Tom Leatherwood	Dig. Meas. Products	7732
George Rhine	Calc. Eng.	235S
Dave Squire	RFI	5146
Andy Bruns	Portable Instruments	7017

Would a seminar on the General Purpose Interface Bus be of use to you? If you think it would, drop a note to Dave Squire at 50/395 stating what you would like the seminar to cover.

TRUCKING...

No, it's not an indoor tennis court after all! Bldg. 58 is receiving the first new tenants, and although moving dates are very tentative, here are the lucky winners so far . . .

Digital Measurement Products (John Gates's group)		Effective Date
DMP Staff (John Gates)	58-149	2-10-75
DMP Operations (Bill Snell's group)	58-134	2-10-75
DMP Sampling (Dave Hannaford's group)	58-293	2-10-75
DMP HS Digitizing (Jim Cavoretto's group)	58-293	2-10-75
DMP DPO Software (Bruce Hamilton's group)	58-157	2-10-75
DMP Manuals (Dale Aufrecht's group)	58-157	2-10-75
Medical Products Manager (Glenn Pelikan)	58-098	2-10-75
Medical Products Marketing (Reagh Stubbs)	58-098	2-10-75
Curve Tracer Products Manager (Jack Millay)	58-149	2-10-75
Curve Tracer Marketing (Ken Lindsay's group)	58-293	2-10-75
Communications Division (Tom Long's group)		
FDI Engineering Staff (Bill Peek's group)	58-733	1-6-75
FDI Electrical Engineering (Morris Engelson's group)	58-736	1-6-75
FDI Mechanical Design (Jack Doyle's group)	58-749	1-6-75
FDI RF Instruments (Thor Hallen's group)	58-733	1-6-75
FDI ECB Design (Paul Fischer's group)	58-747	1-6-75
FDI Marketing (Dave Friedley's group)	58-741	1-6-75

continued on next page

TRUCKING...

		Effective Date
FDI Prototype Support (Chuck Shaw's group)	58-791	1-6-75
FDI Manuals (Russ Stasel's group)	58-742	1-6-75
TV Manufacturing Administration (Charles Rhodes's group)	58-683	3-1-75
TV Manufacturing Development (George Smith's group)	58-638	3-1-75
TV Manufacturing Standards (Art Wade's group)	58-627	3-1-75
TV ECB Design (Bill Cartwright's group)	58-539	3-1-75
TV Wave Monitors (Jerry Wick's group)	58-619	3-1-75
TV Vectorscopes (Paul Miller's group)	58-616	3-1-75
TV Custom Instrumentation (Marge Furukawa's group)	58-624	3-1-75
Waveform Monitors (Bill Ewer's group)	58-662	3-1-75
Picture Monitors (Ron Richardson's group)	58-724	3-1-75
Flow Solder	58-708	3-1-75
ECB Assembly (Nick Hughes's and Luke Crumly's group)	58-758	3-1-75
Specialty Stock (Mike Ruscigno's group)	58-753	3-1-75
Kit Preparation	58-767	3-1-75
Hardware Insertion	58-761	3-1-75
TV Engineering Staff (Steve Kerman's group)	58-639	3-1-75
TV Prototype Support (Stan Tate's group)	58-583	3-1-75
TV Marketing (Cal Smith's group)	58-699	3-1-75
TV Generators (Jim Tormey's group)	58-719	3-1-75
TV Cab/Pack (Otho Weaver's group)	58-775	3-1-75
TV Manuals (Brad Webb's group)	58-586	3-1-75
TV Administration Conference Room	58-682	3-1-75
TV Screen Room	58-599	3-1-75
TV Engineering TEK CYBER 73 terminal	58-532	3-1-75
Switch and Relay Design (Irv Sherbeck's group)	58-021	1-20-75
Engineering Products Design (Chuck Corbridge's group)	58-188	2-3-75
Accessories Engineering (Wendell Damm's group)	58-079	3-20-75
Accessories Marketing Riley Stock's group)	58-129	3-20-75
Xerox & Mail Room		
1st level	58-084	3-20-75
2nd level	58-626	3-20-75

Call for papers

2nd ISPRA NUCLEAR ELECTRONICS SYMPOSIUM

MAY 20–23, 1975

SPONSOR: Nuclear and Plasma Sciences Society and North Italy Section of the Institute of Electrical and Electronics Engineers will sponsor the 2nd Ispra Nuclear Electronics Symposium, to be held in the "Palazzo dei Congressi" at Stresa (Lago Maggiore), Italy.

The Euratom Joint Research Center of Ispra will take care of the organization.

TOPICS: Original papers will be welcome on the following subjects:

- Analog processing of nuclear signals
- Digital processing of nuclear signals
- New CAMAC developments
- Electronics in environmental research
- Biomedical electronics
- Electronic developments related to advances in detectors
- Trends towards picosecond pulse techniques
- Extension of nuclear techniques to other fields.

English will be the official language of the Symposium.

ABSTRACT: Both a 50 word abstract and a 500 word summary must reach the secretariat not later than January 25, 1975.

OTHER: Final manuscripts will be required at the time of the conference. Registration forms, programs, and additional information on the symposium will be distributed later. The proceedings of the symposium will be published by Euratom. A copy will be sent to all the participants.

An instruments exhibition will be organized together with the symposium.

The organizers would like to be informed in advance by the people planning to attend this symposium with or without contributing paper, so that official programmes can be distributed beforehand.

Please write to the secretary of the symposium:

Prof. Luciano Stanchi
CCR EURATOM
21020 Ispra (Italy)

Mailing a second copy to:

Mr. Cesare Ciniselli
Via Al Doyro 6
6815 Melide (Switzerland)

ISA BIOMEDICAL INSTRUMENTATION SYMPOSIUM

APRIL 28–30, 1975

SPONSOR: IEEE Instrument Society of America, Bioengineering and Biomedical Instrumentation Section will sponsor the Twelth International Rocky Mountain Bioengineering Symposium to be held at the University of Colorado Medical Center, Denver Colorado.

TOPICS: Papers may be on any aspect of bioengineering. It is expected that sessions will include but not be limited to the following topics:

Health Care Delivery
Biomedical Instrumentation
Prostheses
Pattern Recognition
Biological Control Systems
Computers and Patient Monitoring
Grounding and Patient Safety
Wildlife Management
Biomedical Systems Analysis
Ecological Applications

ABSTRACT: Receipt of abstract
(200 words, one page only) ..... January 1, 1975

OTHER: Notification of acceptance ..... January 15, 1975

Receipt of completed paper (6 pages) ..... February 15, 1975

Send all abstracts to:

RMBS, c/o Bioengineering
University of Colorado Medical Center
4200 East 9th Avenue
Denver, Colorado 80220
303/394-8351

APPLIED MAGNETICS WORKSHOP

JUNE 5, 6, 1975

SPONSOR: IEEE Magnetics Society will sponsor the 1975 Applied Magnetics Workshop to be held at Marquette University, Milwaukee, Wisconsin.

TOPICS: Papers will be considered which cover application of magnetic theory, materials, or devices. Some typical areas of interest are:

Measurement of magnetic characteristics and properties
Permanent magnet materials and applications
Models and modeling of electromagnetic devices
Solution of electromagnetic problems
Magnetic control application
Magnetic forces
Magnetic materials in power devices
Static inverters, converters, and frequency changers

ABSTRACT: A 300 to 500 word summary of the paper should be received by January 15, 1975. These should be sent and questions referred to the Program chairman.

OTHER: Authors of accepted papers will be notified by February 15, 1975, at the latest. Final copy ready for reproduction will be due March 15, 1975. Instructions for preparing a final copy will be sent to authors of accepted papers.

Professor T. Berstein, Program Chairman
Electrical and Computer Engineering Department
University of Wisconsin
Madison, Wisconsin 53706
Phone: 608/262-3940

continued on next page

1975 IEEE SYMPOSIUM ON APPLICATIONS OF FERROELECTRICS

JUNE 9–11, 1975

SPONSOR: The IEEE subcommittee on Ferroelectronics announces the 1975 IEEE Symposium on Applications of Ferroelectronics (SAF) to be held June 9–11, 1975 at the Albuquerque Hilton Inn, Alburquerque, New Mexico, USA. The 1975 SAF is sponsored by the IEEE Group on Sonics and Ultrasonics with the cooperation of Sandia Laboratories, Albuquerque, New Mexico and the Army Research Office, Durham, North Carolina.

TOPICS: Original papers describing significant applications of ferroelectronics and related materials are invited. Topics of interest include, but are not limited to:

- Pyroelectric Sensors — vidicons, arrays, point detectors, etc.
- Memories, Displays and Optical Signal Processors — light deflectors, page composers, holographic memories, correlators, light valve tubes, etc.
- Thin Film Devices and Technology — integrated optics, broad band modulators, surface wave devices, etc.
- Dielectrics and Piezoelectric Ceramics — P.T.C. control devices, barrier layer capacitors, low temperature bolometers, energy storage, etc.
- New Coupling Effects — magnetoelectricity, ferroelasticity, etc.
- Photo-effects in Polar Materials — optical damage, photo dielectrics, photoconductive-and photovoltaic-ferroelectrics, etc.

ABSTRACTS: Authors should submit abstracts (about 250 words) of their papers by January 15, 1975, to the Chairman of the Program Committee:

Prof. L.E. Cross
Materials Research Lab.-Room 251A
The Pennsylvania State University
University Park, Penna. 16802

OTHER: Authors will be notified of acceptance or rejection of their papers by the end of February 1975. The abstracts of accepted papers will be included in the Symposium Digest. For further information write to the Symposium Chairman:

C.E. Land
Sandia Laboratories
Division 5113
Albuquerque, New Mexico 87115

MACHINE PROCESSING OF REMOTELY SENSED DATA

JUNE 3, 1975

SPONSOR: Laboratory for Applications of Remote Sensing, Purdue University.

TOPICS: Papers are solicited in all areas of theory, implementation and applications of machine processing of remotely sensed data. The following are representative examples of areas that are within the scope of the symposium.

Digital, analog, optical and hybrid processors
Storage and retrieval techniques
Clustering and classification techniques
Automatic referencing to ground coordinates
Multitemporal data registration
Distortion correction
Processing and calibration
Agricultural, forestry, geological and hydrological surveys
Environmental monitoring
Land use planning
Weather analysis and prediction
ERTS and SKYLAB experiments

ABSTRACT: Deadline for submission of
1,500 word summary ..... January 10, 1975

OTHER: Selection of papers will be made by a committee of nationally prominent workers in the area on the basis of originality, usefulness to others in the field and clarity of presentation. All accepted papers will be reproduced in the **Symposium Proceedings.**

Authors' notification of
paper selection ..... March 10, 1975

Completed papers
submitted as typed
reproducible copy ..... April 10, 1975

Symposium ..... June 3, 1975

Four copies of a 1,500 word summary may be sent to:

Prof. C.D. McGillem
Laboratory for Applications of Remote Sencing
Purdue University
West Lafayette, Indiana 47907

1975 ELECTRICAL AND ELECTRONIC MEASUREMENT AND TEST INSTRUMENT CONFERENCE

MAY 13–15, 1975

SPONSOR: The 1975 Electrical and Electronic Measurement and Test Instrument Conference will be held May 13, 14, and 15, 1975 at the Skyline Hotel, Ottawa, Canada. The conference is sponsored by the Ottawa Section of the IEEE and by the IEEE Group on Instrumentation and Measurement. The U.S. Commision I of URSI will be a participating sponsor.

TOPICS: Original papers (not submitted elsewhere) are invited. Subject areas of interest include:

1 Innovative instrumentation developments in the areas of DC and AC measurement from low frequency thru microwave.

2 The development of instrumentation standards in the newer fields of environmental quality and pollution control.

3 The use of microprocessors and other LSI for the enhancement of instrument capability.

4 The design and specification of computer or calculator controlled instrumentation systems.

5 Advances in time and frequency technology.

6 New instrumentation in the area of digital measurement.

continued on next page

Call for papers

ABSTRACT: Three copies of an abstract and a summary of each paper should be submitted to the chairman of the Technical Program Committee, Mr. Donald E. Lawrence, Hewlett-Packard Co.,Automatic Measurement Division, 974 E. Arques Avenue, Sunnyvale, California 94086. The abstracts should be less than 200 words and without illustrations. The summary should be limited to 500-1000 words and may contain a few illustrations and will be used to aid the committee in selecting suitable papers for the conference. The abstracts of selected papers will be used for publicity and program purposes. The deadline for receipt of abstracts and summaries is December 31, 1974.

OTHER: Authors of selected papers will be asked to submit three copies of their complete manuscript, including original illustrations, to the Conference Editor prior to the conference. Further details will be provided.

General questions concerning the conference should be directed to:

Mr. Richard F. Clark
Conference Chairman
National Research Council
Division of Physics
Montreal Road
Building M—36
Ottawa, Ontario, K1A OS1
Canada

Complete Call For Papers information is available from Technical Information 50-462 or call Joyce Lekas, ext. 6601.