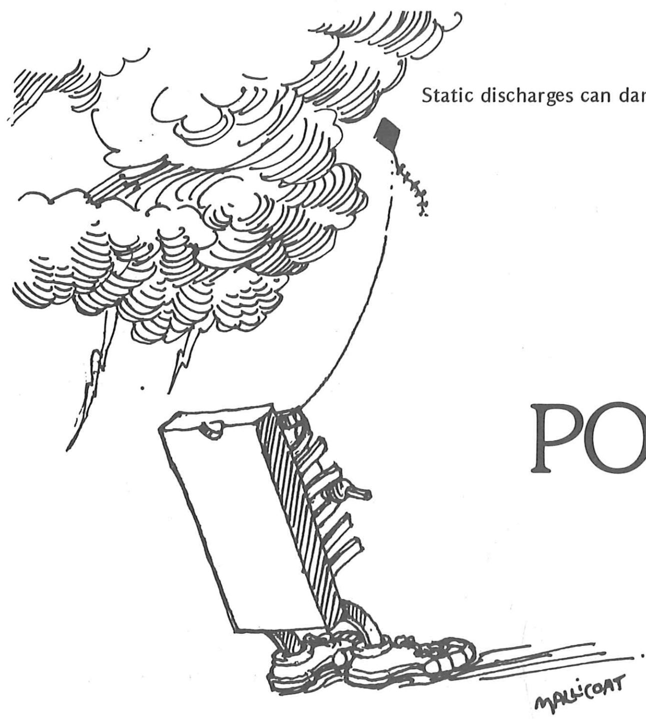
Engineering News

COMPANY CONFIDENTIAL

VOLUME 3 / NUMBER 1 JANUARY 1976 JOYCE LEKAS, EDITOR X6601 RHYS SCHROCK, ASSOCIATE EDITOR X6071 D.S. 50/462



Static discharges can damage sensitive solid state components.

PINK POLY PACKAGING PROTECTS PARTS

Those persons who did not attend Dan Anderson's entertaining seminar on static control in November will have a chance to see a repeat performance January 13 and 14. Dan, from Richmond Corporation, Division of Pak-Well, focused attention on static electricity damage to sensitive solid state components. He started with basics, describing what static charges are, where they come from, and what problems are caused by uncontrolled static discharges. Methods for controlling static were presented, most of them costly, awkward or ineffective. Finally, he presented his own product, Richmond RC AS-1200 or "pink poly." This pink polyethylene is impregnated at the resin stage with an internal, non-corrosive organic antistatic liquid which migrates to the surface of the film. It combines with moisture in the air to form a sweat layer on the plastic surface. The sweat layer bleeds off any static charges to ground. This sweat layer cannot be removed by exposure to low relative humidity.

Providing a moisture layer to bleed off static charges was discovered accidentally in 1949. A company producing polyethylene bottles washed them with a detergent and rinsed them in water to provide clean bottles to customers. A lazy employee saved time by not rinsing the bottles. It was discovered that the detergent film gave the bottles temporary anti-static properties. Detergent was added to the polyethylene formula, producing the first anti-static polyethylene.

Static can cause problems not only in shipping large quantities of components to manufacturers, but also in all stages of handling and assembly. For example, an engineer →

Annie Krueger, Spectrum Analyzer Manufacturing, working at a static free work bench. Note pink poly working surface, pink poly bags, and wrist strap to ground.

may design a circuit around a component whose values have been changed by static discharge. Later attempts to reproduce it with good components will fail.

Tektronix is replacing many packaging materials with pink poly. This includes Air-Cap polyethylene packaging material and pastic bags. There are plans to make pink poly trays to replace the present Styrofoam circuit board carriers. We are also looking into vacuum forming the trays that are used in the IC areas. Vacuum forming and injection molding pink poly does not affect its anti-static properties.

As a few people found when attempting to add timers to their HP-45's, static charges from a person's body can blow a delicate circuit. Fifteen "static free" work benches have been installed in six different production areas. They are:

Medical Instruments	Roger Davidson 39-641
Spectrum Analyzers	Walt Williams 39-514
S Systems	Mike Stansell 39-792
Incoming Inspection	Bernie Dwigans 70-588
Manufacturing Engineering	Milt Wetherald 19-668
Reliability Group	Clair Gruver 39-015

The working surface will be covered with 60 mil pink poly sheet. The worker will be grounded to the sheet with a wrist strap. All plastic materials will be kept away from the work area. The device to be worked with is "naked" except for pink poly, black conductive polyethylene (Velostat), and metal objects. The item will arrive in anti-static packaging, and will leave protected in the same way. The effectiveness of these areas will be evaluated to determine whether more benches should be installed.

Tek is now requiring that vendors use pink poly packaging for sensitive components through the Tek Pak Program. We are also considering the possibility of injection molding polyethylene parts that are used in our instruments from pink poly where such parts made of plain poly cause static problems.

Dan Anderson is scheduled to talk in the Technical Center Auditorium on January 13 at 9:15 a.m. He will be at the Wilsonville Auditorium on January 14 at 9:15 a.m.

For more information, details, or assistance, call Sil Arata, ext. 6585 and Milt Wetherald, ext. 5276.

PRODUCTION & INVENTORY CONTROL

Production and Inventory Control is an attempt to keep inventory size and plant operation costs low, while maintaining a supply of materials adequate to keep production at maximum capacity. These concepts are in conflict; therefore, the goal is to find the most inexpensive way to control these objectives under one system. Production and Inventory Control is accomplished by planning future requirements. This is done by Forecasting, Inventory Control, use of Economic Ordering Quantities, Lead Time Control, and Materials Control.

History

As factories grow larger, it becomes harder to keep track of materials and labor time. Industrial growth since the early 1800's has resulted in many attempts to develop production control systems. A prominent New England company had a department in the 1890's known as the "Hurry-up Department." A modern equivalent is the expediter, or person who tries to sort out the mess when production schedules are behind. Inventory control systems were developed long before they were applied on a large scale. Early developments were ignored by companies who experienced fight for economic survival in the 1930's. Post war prosperity provide a ready market for goods, eliminating the need for production controls.

In the late 50's computers were used to store and compile the inventory quantities and relationships. Although the computer offers nearly unlimited storage capacity, men →

must develop the proper information handling systems and instruct the computer in the application of basic Production and Inventory Control concepts.

Forecasting

Many types of forecasts are used in planning for the future. Long-range forecasts provide for plant expansion and capital investments when new space and machinery are required to accommodate new product lines.

Intermediate-range forecasts provide for materials that must be ordered in advance, or for seasonal materials and products (raincoats, snowshoes, swimwear, etc.).

Production and Inventory Control uses intermediate-range forecasts primarily as the basis for adjusting the rate of flow of materials. At Tek, the horizon of this forecast is typically 13 periods. We make a new forecast of our business every six months; more often if there is a major shift in market demand on a particular instrument. A new instrument line like the T-900 would tend to see periodic shifts and adjustments in forecast figures because we know less about its standing in the marketplace.

Short-range forecasts determine the proper quantities required to maintain production at a steady rate.

Ideally, if a company sold twelve items a year, planning enough parts to produce one item a month would meet production needs. But there are fluctuations in demand for products. Sales for recreational products drop during recession. Seasonal changes are reflected by clothing sales. Toy companies are flooded with work as Christmas approaches.

Inventory Control

It would be nice if a company could maintain a near zero inventory and still keep production up. Inventories are expensive to maintain, but their size must reflect production needs. Customer service must be able to respond quickly to customer needs; changes in production level occur frequently; inventories must be replaced as they are used up; and it is expensive to move complete jobs to and from inventory.

Very large inventories will provide for all these needs, but incur other costs to a company. Parts become obsolete, deteriorate, and are subject to taxes and insurance. Storage space must be paid for, and money invested in inventory is not available for investment elsewhere.

Some items that engineers use in their designs can be forecast accurately. Some cannot. Our inventories are all part of a planned forecast. Whenever parts from inventory are released for engineering use, shortages can occur. The best use of an inventory must be prioritized and the parts distributed accordingly.

During the past year manufacturing inventories have been reduced substantially, resulting in cost savings. This occurs when planning figures become more accurate and believable. Unnecessary safety margins have been eliminated, but the problem of ordering parts that have not been forecast is increased and shows up when unexpected design requirements occur.

Economic Ordering Quantity (EOQ)

The ideal quantity of an item to order is determined by the EOQ formula. It balances the costs of placing orders against the costs both of materials and maintaining them in inventory. It is expressed by the formula:

$$\text{EOQ} = \sqrt{\frac{2AS}{I}}$$

where: A = annual usage in dollars
S = ordering cost in dollars
I = inventory carrying cost as cost per dollar of average inventory. The result is the ideal economic lot size in dollars.

Another consideration is that items are often cheaper when ordered in large quantities. Seasonal anticipation also applies.

New EOQs are presently being established for all components. This is done at six month intervals to insure that the economics are based on current production levels. Tektronix also employs computer simulation of manufacturing and production capacities to help determine inventory requirements.

Lead Time Control

Lead Time is the time that elapses between the moment an item is seen to be needed and the moment the item becomes available for use. For ordered parts, lead time is the supplier's delivery time. Manufacturing lead time is a combination of set-up time, actual working time, transportation time, the time items spend waiting on a loading dock, and the time a job spends waiting to be worked on.

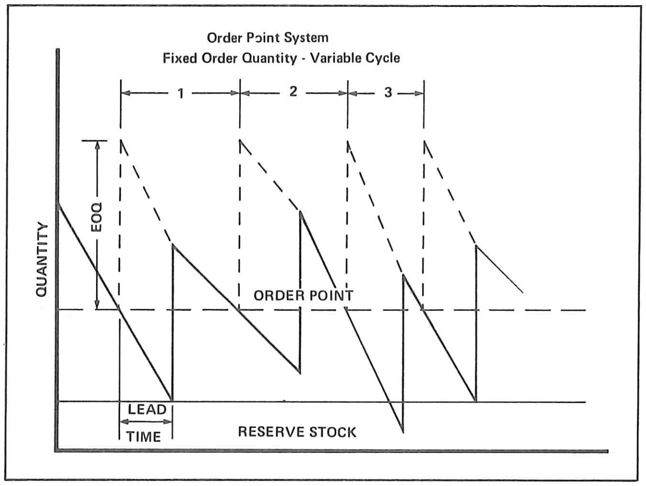
Manufacturing lead times are often extended to make sure that items are ready in time. But as supplier's delivery lead times are increased, customers will increase the size of their order to compensate, thus increasing the backlog.

To control production rate and avoid backlogs, the **input** must be kept equal to or less than the **output**. Capabilities of the machines and people must be known, as well as lead times and materials supplies.

Good input/output control is the secret to making production lines operate smoothly and efficiently. To do that, Tek looks at the amount of work being done in any particular area, and maintains the flow of work at a level that the area can keep up with. This system should prevent backlogs from developing. →

Materials Control

Materials must be replenished regularly to keep up with production. An Order Point system is used.



An Order Point system determines when stock items must be reordered.

When the quantity of an item in stock drops past a certain level, it is reordered. Allowances are made for lead times. Order Points should be periodically reviewed to make room for changes in demand fluctuation.

About ten years ago, Tek adopted the Materials Requirement Planning System (MRP) to replace the Order Point System. Materials Requirement Planning is also called the Netting System at Tektronix. It is a computer based system. A product is broken down through a bill of materials to the various levels of sub-assemblies. The computer looks at the requirements of the individual parts and sub-assemblies and compares that with the current inventory balance. It determines when parts should be ordered to insure that sub-assemblies are completed within the requirements of the total production plan.

The system is mechanically sound. Lead times and EOQ are used properly, but results still depend on the accuracy and regularity of input provided by human hands. Projects are under way to correct the base data that is fed to the system.

Conclusion

Although MRP has been in use at Tek for ten years, and some of the other tools of Production and Inventory Control were used independently in various areas for some time, it has been only in the past two years that Tek has begun to develop a complete and organized company-wide Production and Inventory Control System.

The system is not currently applied to all areas, but will be in the future. It is showing favorable results. We are operating with less money tied up in inventories while increasing the service that these inventories provide.

When operating with more efficient inventory levels, it is important for design groups to look to the future and forecast material usages where possible. Through a company-wide cooperation a Production and Inventory Control System can be used to our fullest advantage.

Most of the background information for this article was taken from the book, "Production and Inventory Control" by Plossl and Wight. Ken Goodall supplied the information about the application of these methods at Tektronix.

Tek Labs Display Program

Display technology plays a major role in Tektronix product lines. CRT's provide a visual display of information in a variety of ways. These include waveforms, graphics, and video displays. It is important that our short and long term needs in this area be understood and planned for.

Tek Labs has assembled a report of their development program for display devices. Sections include; significance of displays to Tek's business, Tek's future display requirements, the possible impact of new display technologies on Tek, and the trends and development in display R&D, both at Tek and in the world.

For information about this report, please call Kevin Considine, ext. 5212.

FLAT PANEL DISPLAY TECHNIQUES

Today's display technology can be divided into three major groups: Cathode Ray Tubes (CRTs), projection devices, and flat panel devices. The most familiar display on Tek equipment is the CRT, although in some instruments requiring only digital readouts, LEDs are beginning to appear. Various Flat Panel Devices are currently being researched throughout the world. It is anticipated that some of these will eventually find application in Tek products. A very brief description of a few of the more prominent flat panel displays follows.

→

FLAT PANEL DISPLAY CHARACTERISTICS

Criterion	Plasma Panel AC	Plasma Display DC	Light Emitting Diodes (LED)	Electro-luminescent Film (ELF)	Liquid Crystal	Digital-Address Cathode Ray Tube (CRT)
- Viewing Area	8 1/2" x 8 1/2" 60ℓpi 12.3" x 12.3" 83ℓpi	3.5" x 8" 33 ℓpi	6" x 6" 20 ℓpi	6" x 6" 20 ℓpi 5"x7-1/2" 40ℓpi	16" x 20" 9 ℓpi 1" x 1" 100ℓpi	3" x 5" 55&40 ℓpi 7" x 7" 80 ℓpi 9" x 9" 55 ℓpi
- Highest Resolution Demonstrated	100 lines/inch	50 lines/inch	60 lines/inch	100 lines/inch	100 lines/inch	80 lines/inch
- Display Brightness	50 fL	25-50 fL	50 fL	50 fL	Reflective	50 fL
- Luminous Efficiency	0.3 Lum/Watt	0.3 Lum/Watt	0.3 Lum/Watt	1 Lum/Watt	Not Applicable	To 35 Lumens/Watt Phosphor Dependent
- Contrast Ratio	Moderate	Moderate-High	Moderate-High	High	Moderate-High	Moderate-High
- Power Consumption	Moderate	Moderate	High	Moderate	Low	Low-Moderate
- Switching Voltage	~100 vac	~100 vdc	~5 vdc	~100 vdc	~20 vac or dc	~70V(requires 10kV phosphor supply)
- Sustain Voltage	~200 vac			250 vac		
- Estim. Avg. Pwr. for 512x512 80 ℓpi device--incl. driv.	~300 W	~1000 W	~1200 W	~600 W	~50 W (1)	~80 W
- Element Current Density at 50 fL Element Brightness	.1 A/in^2	.1 A/in^2	10 A/in^2	.2 A/in^2	1→10 $\mu A/in^2$ (1)	Standard CRT Requirements ≈ 4 mA/in^2
- Element Memory	Inherent	None	None	Phosphor Persistence	Can be Inherent	Phosphor Persistence or CRT Type Storage
- Element Response Time	Microseconds	Microseconds	Nanoseconds - No Warmup	Milliseconds - No Warmup	Milliseconds - No Warmup	Microseconds Cathode Warmup <1 second
- Life	10^3-10^4 Hours	10^3-10^4 Hours	Resolution Element Failure 10^6 Hours	Resolution Element Failure 10^4 Hours	Resolution Element Failure - 10^3-10^4 Hours	10^3-10^4 Hours
- Color Potential	Some (Cross-talk limited)	Some (Resolution limited)	Yes - Red thru Green	Yes - Good Range	Some	Yes - Broad range
- Gray Scale Levels	3-4; Circuitry Dependent	5-8; Intrinsic	3-4; Intrinsic	3-4; Intrinsic	3-4; Intrinsic	7-10; Intrinsic
- Display Thickness	<1 Inch	<1 Inch	<1 Inch	<1 Inch	<1 Inch	2-3 Inches
- Modular Capability	Poor	Poor	Good	Good	Fair	None
- See-Through Capability	Demonstrated	None	None	Feasible	Feasible	None
- Addressing Technique	XY Matrix	Self-Scan on XY Matrix	XY Matrix or Lead Per Element	XY Matrix	XY Matrix	XYZ or XYZ Modified

NOTES: (1) As this is a reflective display, values given are those necessary for typical switching (nonprojection).

A summary of the most promising Flat Panel Display technologies.

Plasma Display Panel (PDP)

In the PDP a small volume of gas is contained between two sets of parallel conductors (oriented at right angles to one another). At least one set of conductors is usually transparent. PDPs are by far the most advanced of the flat panel displays and are beginning to find many applications. Both ac and dc PDPs are in use. A visible plasma discharge is observed through one of the conductor surfaces. Features include the flat format, inherent storage, digital readout and hardcopy compatibility, matrix addressability, and electrical readout. They are limited by high switching voltages and complex addressing. They are also expensive.

Light Emitting Diodes (LEDs)

LEDs are familiar to us all in the pocket calculator readouts. Basically, they are solid state diodes that emit light when biased in the forward direction. Tek's TM-500 Series Digital Counters display their information with LEDs. LEDs are rugged, have long life expectancy, and are compatible both with ICs and with digital drive voltages. However, due to the poor efficiency, large current requirements, and difficulty in making large devices, they are only useful in applications requiring a limited quantity of displayed data.

Liquid Crystals (LC)

LCs are organic liquids with molecular ordering similar to that found in solid crystals. Application of a voltage across an LC device causes the material to scatter (depolarize) ambient light. LC displays do not emit light, but are light modulators and can be used in either the reflective or →

transmissive mode. Advantages include: low voltage and power, projection capability, flat format, potentially low cost, and they are viewable in high ambient light. They are limited by slow speed, are highly susceptible to contaminants, require backlighting in low ambient light conditions, and have a poor threshold, making addressing very difficult. These limitations prevent their use in large data displays.

Electroluminescent Display (EL)

EL displays consist of a phosphor type material (thin film or powder) sandwiched between two sets of orthogonal electrodes. ELs were among the earliest flat panel displays and acquired a bad reputation due to premature promises of flat TV products. However, recent developments indicate that this is one of the most promising of the new technologies. Features include low switching voltages, long life, flat format, and good viewability. Some EL panels offer inherent storage with gray scale and the possibility of multicolor operation. However, development is still in the early stages and ways to achieve low cost, obtain adequate uniformity, and reduce the addressing complexity must still be found.

Digital Address Flat CRT

The Digital Address Flat CRT is about two inches thick. It employs a large flat area cathode and a series of digital switching plates. Unlike most displays which use x-y decoding, the Digital Address Flat CRT uses XYZ decoding. The Z-axis reduces switching complexity because fewer connections to the display are required. Digital addressing is possible, as well as storage mode, color display, and high brightness. However, display areas greater than 9 in. are limited, and high voltages are required.

Summary

Some of the key features and characteristics of these flat panel displays are given in the Table. However, it should be emphasized that in applications requiring a high writing speed and high resolution display the CRT will remain dominant for many years to come. Anyone desiring more detailed information may contact Display Research, ext. 7559.

—Walt Goede

Who do I.C. behind that mask?

I.C. PHOTO MASK DEPARTMENT

What does an IC design go through to get from the drawing board to Wafer Fabrication? The IC Photo Mask Department on the second level of Building 50 is responsible for this job, from digitizing the circuit design to providing IC manufacturing areas with 2½-inch square masks, each containing hundreds of separate images.

After an IC design is finalized, layout drawings of the complete circuit are then delivered to the mask department. This layout can be any convenient scale, such as 100 microns per inch or 20 microns per inch. By means of a Pattern Compiler the design is digitized and transferred to magnetic tape.

The information on the tape is then transferred to the photosensitive layer on a glass plate by using a Pattern Generator. The pattern is made up of a series of overlapping rectangles. The complete image is 10x final circuit size and is called a reticule. Details of the process to this point appear in the May 1974 issue of **Engineering News**.

Figure 1. From left to right; D. W. Mann Pattern Generator 3000 control console, Pattern Generator camera, and Step and Repeat camera.

Making the Mask

The reticule plate is placed on a precision reticule frame in the alignment microscope. When the fiducial (reference marks) on the reticule are in alignment with those in the microscope, the glass reticule is cemented to the frame. In this way, all reticules are aligned to the same reference →

point.

The reticule on the frame is mounted in a Step and Repeat camera. The pattern is reduced 10x and repeated hundreds or thousands of times onto a 2½-inch square emulsion plate. This is the master mask.

The emulsion plate is developed in an automatic processor. This is a vast improvement over the previous method of developing by hand with chemicals in a sink.

Several submasters are made from the master by contact printing. The master is then stored in a safe place. The sub masters are used to fabricate working masks for use in IC Manufacturing. Many copies of a mask are required by the manufacturing areas to facilitate mass production of a particular IC.

Hard Surface Masks

Because of requirements for fine pattern sizes and long life, hard surface masks are often made. A hard surface mask is composed of a glass plate coated on one side with chrome/chrome oxide. This coating is only 0.1 micron thick; comparatively smaller than the 4-6 micron thickness on conventional photographic emulsion masks (see Figure 2). The thin layer chrome is patterned by a positive photoresist process which uses a 0.4 micron layer of resist. Hard surface masks allow mask pattern lines as small as 1.0 micron wide, and gaps as small as 1.5 microns.

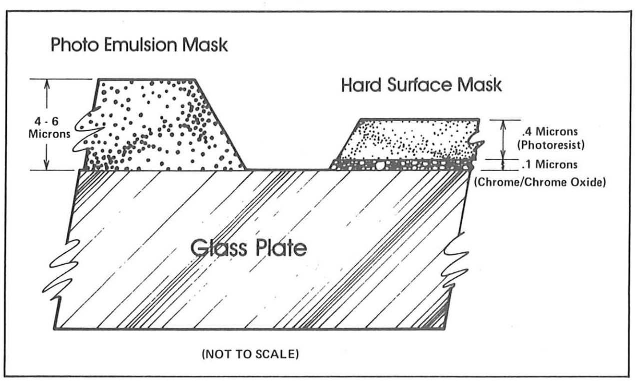


Figure 2. A Hard Surface mask is much thinner than a conventional photographic emulsion mask.

Quality Control

A mask must pass close inspection before it leaves the Lab. Critical dimensions are checked by a Vickers image shearing microscope, an instrument capable of measurements accurate to plus or minus 0.25 microns. Defects are located in the masks by scanning the stepped array with a microscope. A template determines the area to be inspected. A Registration Analyzer checks for alignment between layers. Two masks are placed in the Analyzer which aligns the images optically. In this way layer-to-layer mask registration as tight as 0.25 microns can be insured.

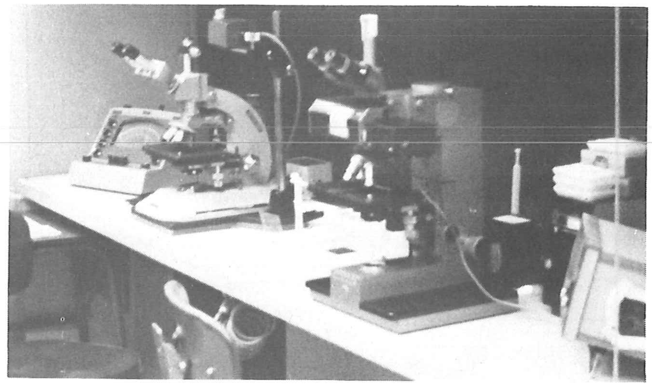


Figure 3. A basic Quality Control station. The defect inspection microscope is on the left, a Vickers image shearing microscope on the right.

Engineering Aids

The Mask Department is responsible for making the 8 x 10 color key copies of the many layered IC design for Engineering and Manufacturing use. The 10x reticule of the circuit is projected onto photographic film by a photographic enlarger. The film is employed in a diazo process which produces the colored layers. A complete set of these overlays represents the many layers of a complete IC.

Figure 4. A complete set of color key overlays represents the many layered integrated circuit to the design engineer.

Other Functions

The Photomask Department makes masks for fabrication of hybrid thin-film circuits, and silk screens which are used to make thick-film hybrid circuits. Both are made for use in the production of CRT faceplate graticules.

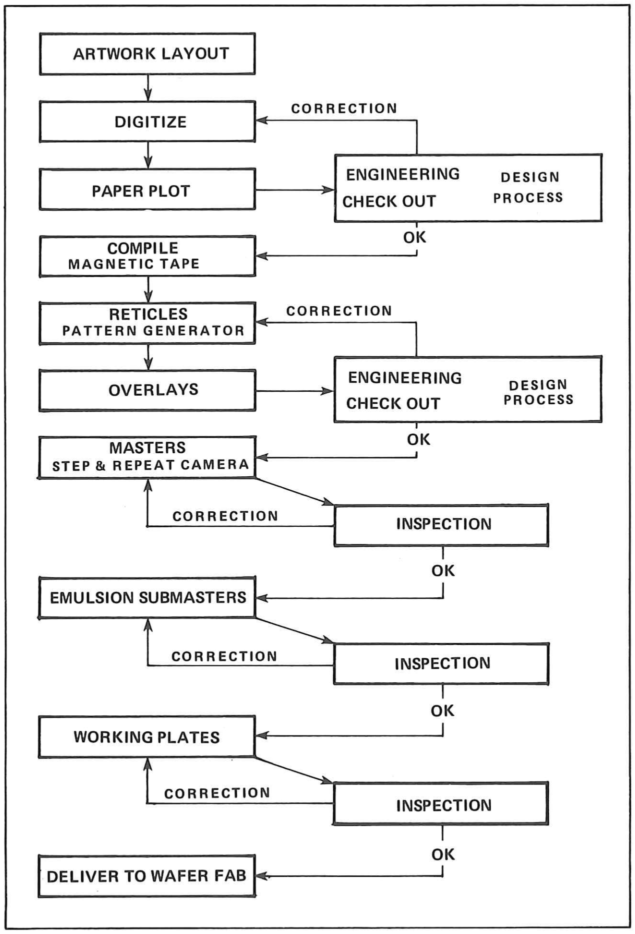


Figure 5. Flow chart shows the many processes involved in making IC masks.

For more information about the IC Mask Department, contact Mel Wright or Larry Land, ext. 5308.

IN PRINT

Chuck Sullivan, Technical Standards, wrote two articles which recently appeared in different magazines. In the October, 1975 issue of STANDARDS ENGINEERING his article is entitled "Trust in Employees: Is The Price Too High?" He analyzes some of the reasons for employee theft, suggesting reasons based in both employee and management attitudes. He points out that honesty in employees is increased when management shows trust in their ability to contribute to company decisions, and when employees are made aware of security problems.

The other article was in the November issue of ENGINEERING GRAPHICS and is entitled "The Twain Must Meet." It is about the lack of communication between industry and drafting classes. This results in graduates well educated in the rules of drafting, but completely unfamiliar with the practical aspects of industrial drafting. He suggests that industry should take a greater interest in the schools, because they will eventually be hiring the graduates from these schools.

IN PRINT

Vince Lutheran, Laboratory Oscilloscope Marketing authored an article which appeared in the November issue of ELECTRONIC PRODUCTS entitled "Using Test Gear for Component Check Out." The article is a "How-and-Why" guide for the use of the differential oscilloscope, but the publisher changed the title. Vince describes the advantages of a differential amplifier in making measurements while rejecting "common-mode" signals. He tells how to use a differential amplifier and cites examples where they have been used successfully. These include medical, computer, communications, component testing and industrial applications.

COMMITTEE MEMBERSHIP

Last month we asked you to help us make your membership on a committee more effective by compiling a list of who is on what committee. This list would be useful for anyone wishing to address problems or comments to a specific group.

We received a few responses and are asking again this month. By filling in the following blanks and sending the information to ENGINEERING NEWS at 50-462, you can help us compile and publish a list of committee membership among Tek personnel. Thank you.

NAME: ______________________

DEPT: ______________________

YOUR COMMITTEES: ______________________

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RETURN TO: 50-462

Improvements In E.C. Lab

If the Etched Circuit Board Lab is to continue to produce high quality multi-layer boards for prototype instruments and engineering use, they must keep up with the multi-layer industry. This industry includes our own Electrochem, which provides circuit boards for Tek production lines.

The E.C. Lab is always looking for new ways to improve the boards they produce. They have added a black oxide process to insure better adhesion. This process, has been used for some time in the multi-layer industry. In it the E.C. material is immersed in a solution that forms a black oxide coating on the copper. When the laminates are pressed and heated, the black oxide coating creates a much tighter bond than the bare copper did.

When the layers are laminated, they are placed between two metal plates and heated in a press. Formerly, two boards were stacked together in the press, causing warpage from uneven heating. Now only one board is pressed at a time and the laminating time has been increased for better curing.

All these processes add quality to our multi-layers, yet have only a slight effect on turnaround time. The 36 hour multi-layer turnaround will be increased by six hours to 42 hours.

—Tino Ornelas
E.C. Lab Manager

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FACTORY/FIELD COMMUNICATION COMMITTEE

A new committee has been chartered to examine and provide improved solutions to the Tektronix Field/Factory, Factory/Field Communication needs. This committee will focus on:

Identifying communication needs
Reviewing present communication vehicles
Determining various alternatives
Recommending courses of action
Implementing approved programs and processes
Monitoring implemented programs and processes
Periodically reviewing programs and processes

Initial members appointed to the committee are:

Marshall Pryor (Chairman)	Advertising
Bob Banford	Base Data Management
Don Watson	Field Operations Services
Jim Hawkins	Field Operations Services
Ron Keitges	International Sales Office
Colin Barton	Information Display Group

Committee membership may vary as needs are identified and prioritized.

-Frank Elardo

TRANSIENT TRIMMING

Hybrid Circuits Engineering is developing a system for transient trimming of hybrid circuits. Components are trimmed so the resulting hybrid will exhibit characteristics to match a desired transient wave form.

A hybrid circuit is measured for transient response and the information processed with an S3030 System. After the results are compared with the desired wave form, the S3030 instructs an ESI Model 25 laser system which trims the appropriate capacitors and resistors.

This system is now being used to produce parts for B-phase instruments. It will eliminate costly manual calibration in some cases, and will make some high performance hybrid circuits possible.

For more information on the Transient Trimming System, contact Jack Hurt, ext. 6545, or Ray Nelke, ext. 6074.

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INTELLIGENCE IN INSTRUMENTATION

Bruce Hamilton, SPS Engineering, gave a talk at the joint meeting of the Circuits & Systems and Instrumentation & Measurement Chapters of the IEEE on December 11, 1975 in Bedford, Massachusetts. He talked about the use of intelligence in the acquisition, processing, display results, and interfacing functions of instruments. Intelligence is the use of microprocessors or asynchronous state machines (ASM) to provide more improved capabilities in instrumentation. He also discussed the direction in which he thought intelligence would cause instrumentation to go.

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S.P.S. PUBLICATION

Signal Processing Systems Group is offering a HANDSHAKE. It is a new quarterly publication for customers who are users of signal processing systems. It will introduce new SPS products, describe signal processing applications, and provide operating and programming hints. HANDSHAKE represents a cooperative effort by SPS Marketing, SPS Manuals, and Advertising.

To make HANDSHAKE relevant to the real world of measurements, they are soliciting articles from both customers and Tektronix personnel. If you are using SPS equipment (DPO or R7912) or related measurement techniques, you are invited to become a member of the "SPS User's Group." To receive a copy of HANDSHAKE call Brenda at ext. 7550. Send articles, ideas, application notes, or program hints to: HANDSHAKE, Del. Sta. 58-157.

Scientific Computer Center

DIALING FOR DATA

Are you having any trouble reaching the Cyber-73 over phone lines? Here are a few phone numbers and hints.

Phone lines to the Cyber:
- From any 4XXX extension:
  - Dial 6 for 110 Baud
  - Dial 5 for 300 Baud
  - Dial 3 for 1200 Baud
- From any other extension:
  - Dial 4 then 6 for 110 Baud
  - Dial 4 then 5 for 300 Baud
- From an outside line:
  - Dial 620-1850 for 300 Baud.

If at any time you have problems regarding these phone lines (i.e. line hits, noise, busy signal when dialing in) please note the terminal number and call Bob Mainero at ext. 5104.

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MICROPROCESSOR USER'S GROUP

In the last issue of E.N., the formation of a Microprocessor User's Group was announced. This group was formed by Bill Lowery, head of the Microprocessor Support Group. It is a forum where microprocessor users can air their needs, exchange information among themselves, be informed of Microprocessor Support Group activities, and formalize some Tektronix Engineering standards for microprocessor hardware and software.

The Microprocessor User's Group membership is limited to one hardware or software engineer from each product or research group desiring representation. Membership is still being solicited and is steadily increasing.

Managers, if your group does not have a delegate to the Microprocessor User's Group, you can contact Bill Lowery at ext. 5865, Del. Sta. 50-454. Give him your representative's name, extension, and delivery station.

The first meeting of the Microprocessor User's Group will be held the first or second working week of 1976.

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WEEKLY KRONOS CLASS

The Scientific Computer Center conducts a class on every Wednesday 10 AM-noon in Building 50 conference room 49. The class is essentially a bull session to deal with any computer-related topics. We particularly stress the KRONOS control language and KRONOS system architecture.

Roy Carlson 7668

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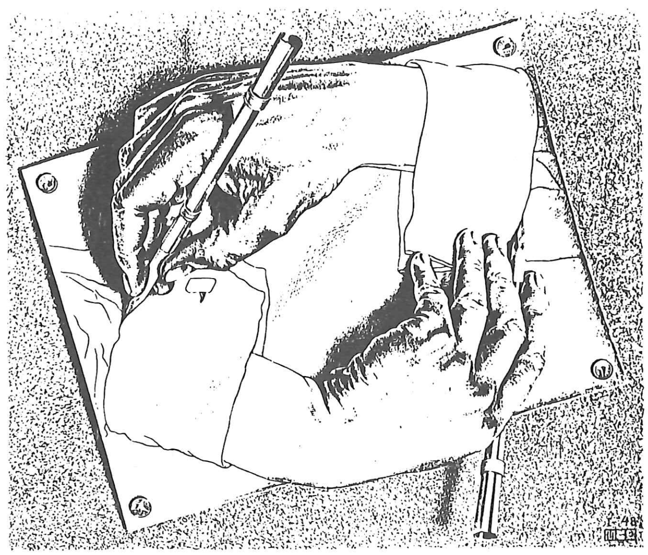

META BEGAT META

The power and flexibility of a programmer's tools determine the power of the programmer. As the art of computer programming reveals new methods and techniques, the programmer must incorporate these advances into current tools and consider the possible development of new tools. If these new tools are not developed, the programmer slips one notch behind the crest of the wave. The farther one slips, the harder it is to catch up.

Programming languages are tools. Up to just a few years ago, most programmers thought of the solution of their problem only in terms of the available tools. If the problem was radically different from the tools of solution, then much time was wasted bending the required problem to fit the existing language. The programmer needed more languages, or a tool which could be used to develop languages.

To solve this problem META was conceived: a programming language for constructing compilers (translators) for programming languages. This powerful concept allows a language to be developed in a minimum amount of time. It makes it possible to tailor a language to fit the problem.

To show that the concept was reasonable and usable, META was developed. . . .written in its own language (META). To modify (enhance) META, the source program is modified. It is compiled by META which in turn yields a new META containing the modification. To verify that the modifications work, the source program is fed into the new META. If the resulting new META is identical to the first new META, then the modifications are valid.

Imagine a machine that, when given the blueprints of a device, could build that device. Let's assume that given any blueprint, the machine faithfully follows the instructions and constructs the specified device. Then to prove that the machine is functioning correctly, give the machine its own blueprints as input. If the machine builds a copy of itself, then we assume that the machine is functioning correctly. If we wish to modify the machine, we modify the blueprints only and feed these into the machine. It builds a new machine that contains the modification. To verify the modification, this new machine is given the task of building an exact image of itself from the blueprints.

One obvious question: Where did the first machine come from? Unfortunately the answer is that it had to be built by hand, but the time spent on that one machine produced a power that is nearly impossible to measure.

A theoretical paper presented in a computer science journal led several programmers to conceive of a new family of tools. These tools are interesting because they are the tools of a tool builder. This brings us one step closer to the ultimate automaton whose program is merely a carefully worded description of the problem.

—Lynn Carter

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NEW PROSE

Recently, a new version of PROSE (a programming language for general purpose programming and higher level calculus programming) was installed on the Tek Cyber 73. Besides reducing the number of bugs in the system, it also added several enhancements to the solvers, including controls on convergence.

To exercise the "new" PROSE, the frequency response of the voltage transfer ratio of a Twin-T (Parallel T) network was optimized to an ideal frequency response. The basic circuit is presented in Figure 1 and the ideal normalized frequency response is presented in Figure 2. (The application of this network was in the feedback loop of a limiting amplifier which resulted in an oscillatory circuit.)

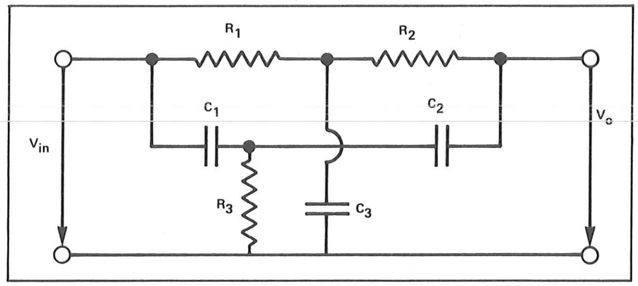


Figure 1. Twin-T basic circuit.

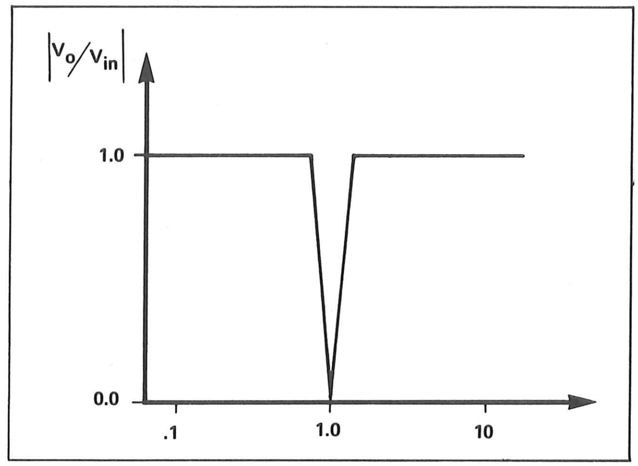


Figure 2. Twin-T ideal normalized frequency response.

The characterization of this circuit can be handled in various degrees of complexity. To keep things simple a "potentially symmetrical twin-T" as described by E. Lueder in the BSTJ, Vol. 51, was used. This twin-T is defined as follows:

$$R_2 = \rho R_1 \qquad R_3 = \left(\frac{\rho}{\rho+1}\right) R_1$$

$$C_2 = \frac{C_1}{\rho} \qquad C_3 = \left(\frac{\rho+1}{\rho}\right) C_1$$

This yields a transfer function of:

$$T(s) = \frac{V_o(s)}{V_{in}(s)} = \frac{s^2 + \left(\frac{1}{R_1C_1}\right)}{s^2 + 2\left(\frac{\rho+1}{\rho}\right)\left(\frac{1}{R_1C_1}\right) s + \left(\frac{1}{R_1C_1}\right)^2} \qquad (1)$$

Using normalized components, normalized frequency, and setting $R_1C_1 = 1$, a zero is obtained at unity frequency. The problem is to find ρ which causes T(s) to approximate the specified ideal response.

The PROSE software system has the capability of creating, editing, compiling, executing, and inspecting output while on-line. Output files can also be created which can be stored permanently, sent to the printer, or edited with SCRIBE or KRONOS editor. The usual procedure is to develop a program under the PROSE editor or a KRONOS editor, compile and execute on-line under the PROSE system, and evaluate the output.

The PROSE program TWINT4 was developed to solve the above problem. The solver which was implemented is called AJAX. It is used to solve systems of equations (linear and non-linear).

Three things should be pointed out about the code. First, the CONTROLLER block allows the user to control the convergence of the solver. Second, the PROCEDURE .PLOTD allows the data to be placed on a PRINTER file. This can be called up by a graphic plotting package (in this case, the SPICE2 plotting package) and obtain plots of the PROSE output data on a graphic terminal.

Third, the CONTROLLER .SET has a statement INTERACT which allows the user to adjust program parameters interactively. The program TWINT4 was compiled and executed on-line with no changes made at "INTERACT" time. The output was sent to a permanent file. The PROSE time-sharing session was terminated. The SPICE2 plotting package with the recently stored permanent file was used to obtain the plots in Figure 3.

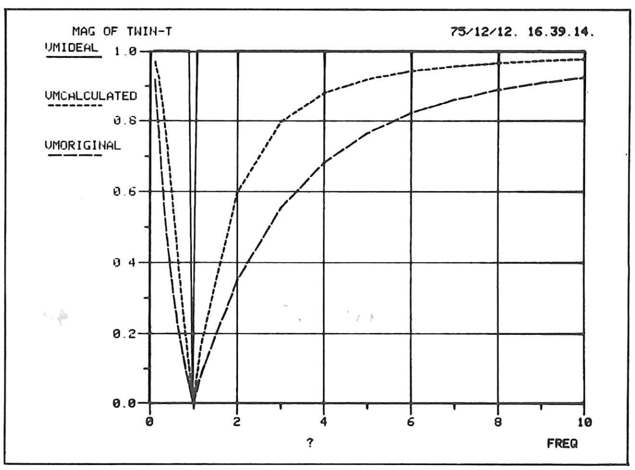


Figure 3. The PROSE output data was plotted on a graphic terminal with SPICE2.

PROSE concluded that ρ should be large to best approximate the ideal response. A comparison of the frequency responses for 1) the ideal case, 2) the case where $\rho = 2833$ and 3) the case where $\rho = 1$ (original) can be made by observing the PROSE output in Figure 4.

```
PROBLEM .TWINT4
ALLOT FRAD(21),IDEAL(21)
ALLOT TMAG(21),ERROR(21)
FRAD=.DATA(.1,.2,.3,.4,.5,.6,.7,.8,.9,1.,1.1,1.2,2.,3.,
          4.,5.,6.,7.,8.,9.,10.)
IDEAL=.DATA(1.,1.,1.,1.,1.,1.,1.,1.,1.,.014,
          1.,1.,1.,1.,1.,1.,1.,1.,1.,1.,1.)

[    R2=RHO*R1              R3=RHO*R1/(1+RHO)
[    C2=C1/RHO              C3=(RHO+1)*C1/RHO

R1C1=1.
RHO=1.
NUMPTS=21
FIND RHO IN .FIT UNDER .SET TO MATCH ERROR
EXECUTE .PLOTD
END


MODEL .FIT
SUMERR=0
     FOR I=1 TO NUMPTS DO
     S==.CVALUE(0,FRAD(I))
     T==S**2+1/R1C1
     DENOM==S**2+S*2*(RHO+1)/(RHO*R1C1)+1/(R1C1**2)
     T==T/DENOM
     TMAG(I)=.MODULUS(T)
     ERROR(I)=TMAG(I)-IDEAL(I)
     SUMERR=SUMERR+.ABS(ERROR(I))
     REPEAT
END


CONTROLLER .SET FOR AJAX
LIMIT=100
DETOUT=0
SUMOUT=0
MAXIT=30
DAMP=0
INTERACT
END


PROCEDURE .PLOTD
SELECT PRINTER
TEXT PRINT 'MAG OF TWIN-T'
     KNTR=2
DISPLAY KNTR IN '******'
     JSTOP=1
DISPLAY JSTOP IN '******'
TEXT PRINT 'VMIDEAL'
     JSTOP=JSTOP+1
DISPLAY JSTOP IN '******'
TEXT PRINT 'VMCALCULATED'
TEXT PRINT '  FREQ  '
     YMIN=.0
     YMAX=1.0
DISPLAY NUMPTS IN '******'
DISPLAY YMIN,YMAX IN '**.*****E*** **.*****E***'
SUPPRESS LABELS

USE 10 FIELDS 12 WIDE
USE 5 DIGITS
ROW PRINT (FOR I=1 TO NUMPTS,IDEAL(I))
DISPLAY YMIN,YMAX IN '**.*****E*** **.*****E***'
ROW PRINT (FOR I=1 TO NUMPTS.TMAG(I))
ROW PRINT (FOR I=1 TO NUMPTS,FRAD(I))
END
```

Figure 4. A comparison of the frequency responses can be observed on the PROSE output.

This exercise was meant to demonstrate the implementation of PROSE. More complex problems can be implemented and solved. For more information, contact Ron Bohlman, ext. 5866.

Call For Papers

The **1977 Spring Meeting and Star Symposium (SNAME)** will be held May 25-27, 1977 in San Francisco, California. The theme of the conference is "Energy Research in the Oceans."

SPONSOR: IEEE Northern California Section in cooperation with the American Society of Civil Engineers, the IEEE Ocean Engineering Council and Energy Committee, and the Marine Technology Society.

TOPICS: Papers are invited on the following subjects, emphasizing work in progress:

Energy Transportation
Offshore Petroleum
Ocean Thermal Energy
Kelp Conversion
Arctic Technology
Cryogenics
Cable and Pipeline
Power Sources (Tidal, wind, current waves).

ABSTRACT: Authors must submit 15 copies of a 400-500 word abstract by March 1, 1976. Finished manuscripts are due by March 1, 1977.

OTHER: Send abstracts to:

RADM N. Sonenshein, USN (Ret.)
Assistant to the President
Global Marine Development, Inc.
4100 MacArthur Blvd.
Newport Beach, CA 92660

The first **Joint Magnetism and Magnetic Materials—Intermag Conference** will be held at the Hilton Hotel in Pittsburgh, Pennsylvania on June 15-18, 1976.

SPONSOR: The American Institute of Physics and the Magnetic Society of the IEEE.

TOPICS: The program will consist of both invited and contributed papers. Areas of interest include:

Experimental & Theoretical Research in Magnetism
Properties and Synthesis of New Magnetic Materials
Advances in Magnetic Technology

ABSTRACT: Abstracts are due by February 20, 1976 and must be prepared in exact conformity to instructions in the Conference information packet. This can be obtained by contacting:

E. W. Pugh
IBM Research Center
P.O. Box 218
Yorktown Heights, N.Y. 10598

or

F. E. Werner
Magnetics Department
Westinghouse R&D Center
Beulah Road
Pittsburgh, PE 15235

The **IEEE Transactions on Microwave Theory and Techniques** will have a special February 1977 issue for the publication of original papers on Low-Noise Technology.

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

Satellite Communication Receivers
Radar Receivers
Terrestrial Communications Receivers
Radio Astronomy Receivers
Radiometers
Low-Noise Parametric Amplifiers
Low-Noise Mixers
Low-Noise FET & Bipolar Amplifiers
Oscillator Noise
Applicable Millimeter Wave Technology
New Low-Noise Devices & Circuit Techniques
Cyrogenic Techniques for Low-Noise Reception
Low-Noise Measurement Techniques

ABSTRACT: Four copies of the manuscript are due before June 1, 1976.

OTHER: Send manuscripts to:

Jesse Taub
AIL Division of Cutler-Hammer
Walt Whitman Road
Melville, N.Y. 11746

The **1976 IEEE Conference on Decision and Control** and the **15th Symposium on Adaptive Processes** will be held December 1-3, 1976 at the Sheraton-Sand Key Hotel in Clearwater Beach, Florida.

SPONSOR: IEEE Society on Control Systems with the →

cooperation of the Society for Industrial and Applied Mathematics.

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

- Control Systems
- Decision Making
- Linear & Nonlinear System Theory
- Stability Theory
- Large Scale & Distributed Parameter Systems
- Application of Systems Theory

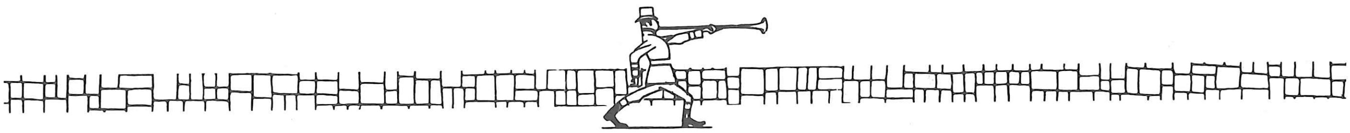
ABSTRACTS: Two types of papers are solicited. The first are regular papers describing completed work in some detail. The second are short papers which present recent, perhaps preliminary results. Prospective authors are invited to submit five copies of their manuscripts for regular papers, or five copies of a 700-word abstract for short papers by April 1, 1976.

OTHER: Papers for the Decision and Control Conference should be submitted to:

Dr. Earl R. Barnes
IBM Thomas J. Watson Res. Center
POB 218
Yorktown Heights, N.Y. 10598

Those for the Adaptive Processes Symposium should be sent to:

Prof. Edison Tse
Department of Engineering—Economic Systems
Stanford University
Stanford, CA 94305



LAST MINUTE NOTICES

The Portland Section IEEE, the IEEE-Engineering in Medicine and Biology Group, and the Electronics Group will have a joint meeting January 27, 1976. Dr. Robert F. Rushmer, M.D., Ph.D. Professor at the Center for Bioengineering, University of Washington will lecture on "Energy Probes for Nondestructive Medical Diagnosis." The meeting will start at the Greenwood Inn with "Happy Half-hour" at 6:30 p.m. and dinner at 7:00 p.m. Dr. Rushmer's lecture will be back at Tektronix in the Bldg. 50 Auditorium at 8:00 p.m.

For more information or dinner reservations call Patty Norgaard, 283-7314 (University of Portland). Reservations must be made by January 23, 1976.

A seminar will be conducted at Portland State, Room 107 Science Bldg. 1 on Tuesday, January 27, 1976 from 3:00-4:00 p.m. Dr. R. F. Rushmer will speak on "Biomedical Engineering, Its Current Scope and Future Prospects."

For more information, call Rich Piazza, ext. 7471.

Maureen Key 60-553