TECHNOLOGY report

HARDWARE SOFTWARE FIRMWARE PROCESS ENGINEERING MATERIALS RESEARCH

HARD COPY

BIG BUSINESS FOR TEKTRONIX

CONTENTS

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Volume 2, No. 1, January 1980. Managing editor: Burgess Laughlin, ext. 8929 (Merlo Road), d.s. 53-077. Editors: Art Andersen and Laura Lane. Cover and graphic design: Joe Yoder. Graphic assistant: Jackie Miner. Typesetter: Jean Bunker. Published by Technical Publications (part of Technical Communications Services) for the benefit of the Tektronix engineering and scientific community.

Why TR?

Technology Report serves two purposes. Long-range, it promotes the flow of technical information among the diverse segments of the Tektronix engineering and scientific community. Short-range, it publicizes current events (new services available and notice of achievements by members of the technical community).

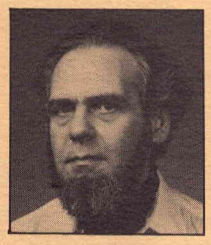
Contributing to TR

Do you have an article or paper to contribute or an announcement to make? Contact the editors on ext. 8929 (Merlo Road) or write to d.s. 53-077.

How long does it take to see an article appear in print? That is a function of many things (the completeness of the input, the review cycle and the timeliness of the content). But the *minimum* is six weeks for simple announcements and as much as 14 weeks for major technical articles.

The most important step for the contributor is to put the message on paper so that the editor will have something with which to work. Don't worry about organization, spelling, and grammar. The editors will take care of those when they put the article into shape for you.

HARD COPY – BIG BUSINESS FOR TEKTRONIX



Jon Mutton, Information Display Division Technology Development Group, ext. 3722 (Wilsonville).

Currently a senior engineer in IDD Technology Development Group, Jon is a major contributor to crt and hardcopy product development. He came to Tektronix in 1964 and helped pioneer direct-view storage tubes. Advanced work in Display Device Development put Jon in the right place at the right time — this group was one of several which combined to form IDD in 1965.

The following article is based on a presentation that Jon gave in Forum 14 in May 1979. (Sponsored by the Engineering Activities Council, Forums enable Tektronix engineers and scientists to present directly to management what engineers and scientists consider important in technology.) The topic of Forum 14 was "Hard Copy."

HISTORICAL BACKGROUND

Late in 1965, the Information Display Division was formed from three advanced development groups in Display Devices Development. Our task was the exploitation of the bistable storage tube which Tektronix invented a few years before.

Our short-term goal was to design and build the 611 Storage Monitor which sold well from about 1965 to 1975. It was the keystone for most of IDD's products. Our long-term goal was to transmit drawings from one location to another via telephone lines. The receiving and display device was to be our storage tube.

Competition, however, forced us to re-examine the long-term goal. In addition, minicomputers were coming onto the scene and Tektronix storage tubes appeared to offer significant advantages in the user-machine interface. Complete pictures would not have to be sent to a terminal designed around our tube. Codes for letters and numbers representing the end-points of vectors could be sent and the storage tube would remember the resulting picture. With this terminal, users would have flexibility in generating and manipulating graphs, charts, and drawings. The success of this effort is evident in the number of companies advertising "Tektronix-compatible" terminals.

THE "HARD" COPY

Computer terminals present the user with "soft" copy, that is, one that cannot be transported, saved, written upon or cuddled as a "security blanket."

At IDD, based upon our work in drawing-transmission and earlier work in oscillography, we recognized the ability of the storage tube to act as a scan converter. This ability could serve as the signal source for a recorder to produce a hard copy. The major question was, could we recover the signal from the 611 Display Monitor without significant modification? This was a difficult task but we completed it successfully.

DEVELOPING THE RECORDER

We had some experience in photographic and electrophotographic systems. Figure 1 lists the technologies available at the time. Using some of these technologies, we constructed several pieces of hardware but we chose to

Continued on page 4

TECHNIQUE	EXPOSE	DEVELOP	SCAN	TYPE OF SCAN
THERMAL	HEAT		MECH/ELECT	DOT, CHARACTER, RASTER
INK JET	INK		MECH/ELECT	CHARACTER, RASTER
DRY SILVER	LIGHT	HEAT	CRT OPTICAL MECHANICAL	RASTER, FRAME
PRINT OUT		LIGHT		DOT, RASTER, FRAME
SILVER HALIDE		CHEMICAL		RASTER, FRAME
ELECTROPHOTOGRAPHY		TONER		RASTER, FRAME
ELECTROGRAPHY	CHARGE	TONER	MECH/ELECT	RASTER
ELECTROLYTIC	CURRENT		MECHANICAL	RASTER
ELECTROSENSITIVE (ZAP)	SPARK		MECHANICAL	DOT, RASTER
MAGNETIC	MAGNET.	TONER	ELECT/MECH	CHARACTER ROW
IMPACT	PRESSURE		MECHANICAL	ALL

Figure 1. Summary of various hardcopy techniques.

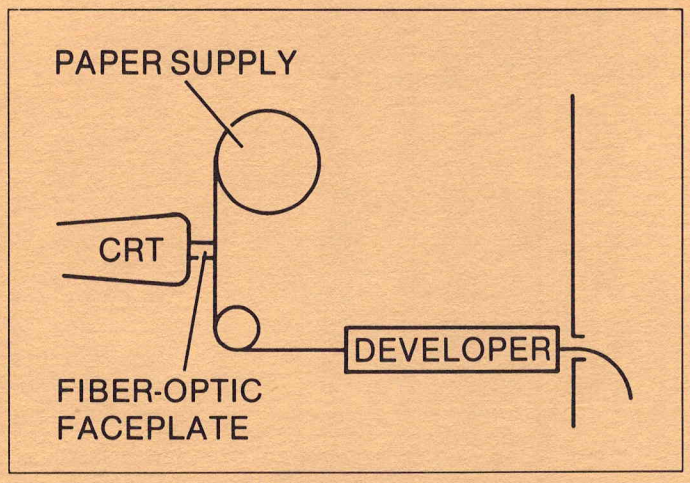


Figure 2. Basic elements of the fiber-optic line-scan copier.

develop a recorder based on two relatively new technologies: 3-M's dry silver paper and fiber-optic faceplates (see figure 2).

Dry silver paper was appealing because no wet-processing steps were needed (wet processing is messy and requires continual replenishment of chemicals). The dry material is exposed with light and is developed simply by heating. Fiber-optic faceplates were expensive and used primarily in military applications, but provided an efficient way of coupling light to the dry silver paper. Because the electrical signals from the storage tube are sequential, a line-scan recorder is appropriate. This allows use of a narrow fiber-optic faceplate on the recorder's crt, reducing its cost.

The result of our effort was the very successful 4601 Hard copy Unit which can copy from the 611 Monitor and from the T4002 Computer Display Terminal. At the time, the 611 was rapidly becoming a standard in information display. The 4601 (shown in figure 3) was the first of the Tektronix copier line.

EXPANDING THE LINE

Once we had recorder technology that worked well, what else could we do with it? There were other images that potential customers wanted to copy. Many alphanumeric terminals used television formats (raster scan) for display. We developed the 4602 and 4620 hardcopy units to accommodate these terminals.

In the 4620, designed specifically for alphanumeric raster-scan terminals, we used a digital "window" scan (a new technique) instead of single-line exposure. The window scrolls at the same rate as the copy unit's paper, producing a well-formed image.

While we were designing the 4010 Computer Terminal, we used the opportunity to eliminate some of the constraints imposed by having to modify previously-designed display devices. An example of such a modification was moving the readout amplifier to the terminal so it would be closer to the signal source. Also, we redesigned circuitry to take advantage of new components. The copier for this terminal was the 4610. All these copiers shared a common mechanical package.

NEW DEVELOPMENTS

Dependence on the 3M Company for dry silver paper processing components, and our inability to vary paper speed led (in 1974) to the development of a completely new mechanical package which appeared in two new copiers: the 4631 and 4632.

The 4631 is electrically and functionally similar to the 4601 and its later version. The 4632 Video Copier is quite different from its predecessors in that it uses a sampled window scan which can copy any video signals. The 4631 and the 4632 share the same mechanical design and have variable speed motor drives and a Tektronix-designed processor.

In 1978, we introduced two more hardcopy units: the 4663A and 4634, both designed for specialized markets. The 4663A is a gray-scale line-scan copier especially suited to such diverse fields as medical ultrasound scanning and oil-well logging. The 4634 is a high-quality video copier. This unit has a mechanical package that provides rack mounting, and is used with medical scanners employing computer-aided tomography. □

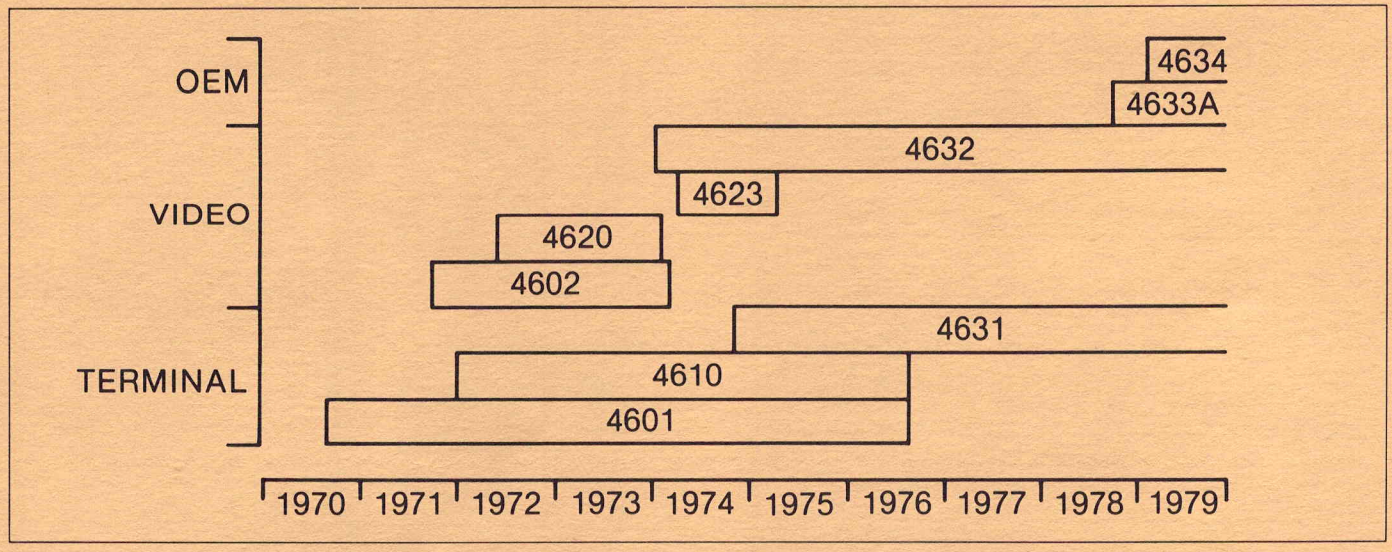


Figure 3. Hardcopy units produced by Tektronix.

1979 INDEX

For a copy of any article from **Engineering News (EN), Software News (SN),** or **Technology Report (TR),** check the appropriate boxes and send a photocopy of this listing to Technical Communications Services, d.s. 53-077.

NAME _____ DELIVERY STATION _____

For a copy of the 1978 Index, see the February 1979 Engineering News.

GENERAL

- ☐ 1978 Engineering News Index, February EN
- ☐ Organizing for High Technology — An Interview with Earl Wantland, March EN
- ☐ Part Numbers for Wires, March EN
- ☐ New Display Journal, March EN
- ☐ GPIB Poster, April/May EN
- ☐ Engineering Notebooks, June EN
- ☐ Producing Successful Slide Shows, July EN
- ☐ The Tektronix Patent Process, July EN
- ☐ Standards vs. Creativity, July EN
- ☐ New GPIB Codes and Formats Standard, July EN
- ☐ GPIB System Concepts, August/September EN
- ☐ Non-Management Career Path Offers Opportunities for Tek Engineers and Scientists, August/September EN
- ☐ Computer Conference May Speed Standards Acceptance, August/September EN
- ☐ PCC Will Graduate First Hardware/Software Technicians in 1980, August/September EN
- ☐ Standards Aid Designers, October TR
- ☐ TEKCOM: A Cyber-Based Electronic Mail System, November/December TR
- ☐ Technology Report's Editorial Process, November/December TR
- ☐ Digital Product Coordination (Profile), November/December TR

SOFTWARE

- ☐ Thermal Analysis on the Cyber, January EN
- ☐ Tektronix Team Analyzes DOD Languages, February SN
- ☐ Business Graphics — Making Computers Work for Management, March SN
- ☐ PASCAL Standardization Moves Forward, March SN
- ☐ Data Base Simulation, April SN
- ☐ 4051 In-House Support, April SN
- ☐ PLOT 10 Family Evolves Interactive Graphics Library, May SN
- ☐ Computer Algebra Language Available, May SN
- ☐ The 4081 Software Maintenance Group (Profile), May SN
- ☐ Interactive Graphics for Hybrid Layout, June SN
- ☐ Mentors Make New Software Designers' Jobs Easier, June SN
- ☐ GPIB Control Using Tek SPS BASIC, June SN
- ☐ New Links to RT-11 Operating Systems, June SN
- ☐ Tek Rep Attends ANSI BASIC Standards Meeting, July/August SN
- ☐ Catalog of In-House Software Tools Undertaken, July/August SN
- ☐ Walkthroughs at Tektronix, July/August SN
- ☐ Avoid Pitfalls in Selecting Automatic Test Equipment, July/August SN
- ☐ Simulating Hardware Prototypes Speeds Product Development, July/August SN
- ☐ Interactive Graphics Library Works with All Tek Terminals, July/August SN
- ☐ New GPIB Codes and Formats Standard, July/August SN
- ☐ Cyber TESLA Version 2 Released, October TR
- ☐ New Tek SPS BASIC Version Available, October TR
- ☐ "FINAL" Analyzes Designed-In-Serviceability/Development Costs Trade-Off, October TR
- ☐ Floating-Point Standard Implemented in TESLA, November/December TR
- ☐ GPIB Interface Functions and Messages, November/December TR
- ☐ Archiving **Does** Make a Difference, November/December TR
- ☐ Standard Identifies Mounting-Hole Patterns, November/December TR

HARDWARE

- ☐ Oscilloscope Sweep-Rate Indicator (Patent), January EN
- ☐ Snubber Design Lets 492 CRT Withstand 150G's, January EN
- ☐ Programmable Attenuator with FET Switching (Patent), February EN
- ☐ Modem Mod for Bad Telephone Lines (Special Design), February EN

Continued on page 6

- ☐ Extracting Sync Information from a Composite Waveform (Patent), February EN
- ☐ Monochrome Presentation of Demodulated Color Signals (Patent), February EN
- ☐ Video Transmission Stabilizer (Patent), March EN
- ☐ A Master-Slave, Clock-Driven Voltage Comparator (Patent), March EN
- ☐ Pulse Peak Detector (Patent), March EN
- ☐ Automatic Trigger Circuit (Patent), March EN
- ☐ Knockdown Stand (Patent), March EN
- ☐ Novar — A Laser-Trimmed, Tweakless Attenuation System, April/May EN
- ☐ Power Supply Design Develops Universal Load Unit, April/May EN
- ☐ Keyboard Circuit (Patent), April/May EN
- ☐ Electric Switch (Patent), April/May EN
- ☐ "Slewed-Edge" Scope Sweep Calibrator (Patent), April/May EN
- ☐ The Risks in Designing with LSI (Part 1 of 2), April/May EN
- ☐ Traveling Wave Deflector for Electron Beams (Patent), April/May EN
- ☐ EMI Shield Device (Patent), April/May EN
- ☐ Feedbeside Circuit Corrects for "Thermals" (Patent), June EN
- ☐ Pulse-Width Normalizer (Patent), July EN
- ☐ Modular Electronic Instrument Cabinets Lower Costs (Patent), August/September EN
- ☐ Automated Instrument Compatibility Evaluation Group (Profile), August/September EN
- ☐ Feed-Forward Amplifier (Patent), October TR
- ☐ Simultaneous Delayed Sweep Display (Patent), October TR
- ☐ Dynamic Damping for SECAM High-Frequency De-Emphasis (Patent), October TR
- ☐ Voltage Switching Circuit Improves Color Display (Patent), October TR
- ☐ Reducing Risks in Designing with LSI (Part 2 of 2), November/December TR

FIRMWARE

- ☐ Finite Element Analysis Solves Mechanical Design Problems, January EN
- ☐ Designed-In Serviceability and Development Costs, January EN
- ☐ Microprocessor Support (Profile), February EN
- ☐ Designed-In Diagnostic Features: Strategies for Instrument Circuitry (Part 2 of 3), February EN
- ☐ Substitutive Emulation, February SN
- ☐ Designed-In Diagnostic Features: Downloading vs. Rom-Residence (Part 3 of 3), March EN
- ☐ Fluke 5101A Calibration Program File, July EN
- ☐ IEEECS Standard Specifies Floating-Point Format for Microprocessors, July/August SN
- ☐ Firmware Production and Maintenance, October TR
- ☐ Z80 Operations Clarified, October TR
- ☐ Data Base and Utility Support (Profile), October TR
- ☐ When Sizing Processors, Three Numbers Are Better Than One, October TR
- ☐ Computer-Aided Mechanical Design Assistance Available, October TR

PROCESS ENGINEERING

- ☐ The Quick Board Line — Electrochemical Support (Profile), January EN
- ☐ Six Mil Lines for Tek PC Boards?, February EN
- ☐ Unilayer — EDE Develops the Fourth Generation of ECB Technology, March EN
- ☐ Automatic Metal Monitor Supports Reliability Assurance, June EN
- ☐ Semi-Automatic Wire-Wrap Offers Many Benefits, June EN
- ☐ Wire-Wrap for Hi-Speed Logic Circuits, August/September EN
- ☐ Minimizing ECB Production Costs, August/September EN
- ☐ APD Studies Thin Gold Finish for Prototype ECB Contacts, October TR

MATERIALS RESEARCH

- ☐ Cobalt Collector-Target Fabrication Produces High Yields (Patent), June EN
- ☐ Housing Shields Stripline Microwave Circuitry (Patent), June EN
- ☐ Powder Coating for Tek Products?, July EN
- ☐ Phosphor Mixture Increases CRT Target Life (Patent), July EN
- ☐ Increasing the Stored Writing Rate of Charge-Image Charge-Transfer CRTs (Patent), July EN
- ☐ New CRT Display Decreases Background Luminance (Patent), November/December TR
- ☐ Thin-Film Barrier Layer Helps Fabricate Metallized Substrates (Patent), November/December TR

PROFILE

STANDARDS INCREASE TEK QUALITY

The Technical Standards group keeps Tek employees abreast of industry standards. The group members are: *standing, left to right,* Carol Whitmore, Roy Eckelman, Bonnie Kooken, and Kathy Halpert; *seated, left to right,* Pauline Whitmore, Chuck Sullivan, Ida Martyn, and Naomi Quentin.

With increasing pressures for product safety and safety in production processes, Tektronix management's awareness of the value of standards is steadily growing. Additionally, the demand for standards is increasing with the need for certification of instruments and components to meet not only national, but international requirements as well.

SOURCES

In formatting company standards, Technical Standards functions as a *writing* group. Other Tektronix employees are the source of a new standard. The person suggesting a new standard is responsible for (1) providing the information Technical Standards needs to write the standard or (2) identifying the people or documents from which a standards writer can obtain the information.

Technical Standards issues standards only with the approval of the people who are involved with, or most affected by, the new standard. Where applicable, the standard will identify groups needing to control changes to a standard.

STANDARDS INFORMATION SOURCES

From outside the company, Technical Standards acquires military, industrial, national, and international documents (such as UL 1244, IEEE 488, and ANSI 41.1). Bulletins, indexes, and public media keep Technical Standards' group members aware of new and revised documents.

Technical Standards utilizes several media to provide information on available documents. The **Tektronix Directory of Standards** lists the standards produced by Technical Standards for Tektronix use and is available to all who request it.

A computer index, located at all library stations, lists external documents (documents available from outside Tektronix). These documents are usually available on loan for a negotiable period. If a Tektronix employee requests an external document that the group doesn't carry, Technical Standards will order it; if there is a cost, the requesting group pays for the document.

Tektronix in-house publications, such as **Technology Report** and **Component News,** are another source of Standards information.

OTHER FUNCTIONS

As an extension of their standards function, Technical Standards helps other groups control their guidebooks and department publications by securing an identification number (for example, 062-0000-00) for each document or a portion of the document. Technical Standards will distribute copies of pertinent documents and their subsequent updates.

THE PEOPLE

Technical Standards employs four writers: Roy Eckelman, Ida Martyn, Naomi Quentin, and Pauline Whitmore. Carol Whitmore is the group's technical aide and Chuck Sullivan is the manager.

The Technical Standards secretary, Bonnie Kooken, directs distribution of documents. Call ext. 241 (Town Center) for a copy of any document listed in either the **Directory** or the computer index.

Upon request, Bonnie will contact outside agencies for information about standards not in Technical Standards' files. A clerk, Kathy Halpert, oversees the mailing of revisions to holders of Tektronix standards.

Technical Standards is a part of Product Safety under Pete Perkin's management.

FOR MORE INFORMATION

For standards assistance, call Technical Standards at ext. 241 (Town Center), or write to d.s. 41-260. □

COMPONENT INFORMATION SYSTEM UP AND RUNNING

Harriet Krauss, Component Information Group (in Engineering Support), ext. 4710 (Beaverton).

The Component Information Group in Engineering Support is developing a Component Information System (CIS) that serves engineering, manufacturing, and support groups throughout Tektronix. The system provides a wide range of data about purchased components used in Tektronix products.

CIS resides in the Cyber 73 computer. The system uses a commercially available data base package, System 2000, which Tektronix purchased from MRI (a division of Intel). Any user at Tektronix who has a Cyber terminal can access information.

TWO SETS OF DATA

The first major blocks of information are already available. One set of data provides general information about each purchased component:

- Tektronix part number
- item name
- base data description
- status
- buyer
- responsible component engineering group

(For a sample display, See figure 1).

A second set of data contains all the information found on the Purchased Item Source List (PISL). The PISL for a given part number identifies the manufacturers from whom Purchasing buys the part. (For a sample display, see figure 2).

QUERIES

A query capability enables you to FIND all components in

Figure 1

```
                    GENERAL INFORMATION ON   156-0422-00

ITEM NAME: MICROCKT,DGTL                    PURCHASED
           UP/DOWN SYN BINARY COUNTER 74LS191,TTL,16 DIP


STATUS:     CR CURRENT PRODUCTION
 *WARNINGS: SOURCE IS CONTROLLED

 BUYER:     1T STUCKI KEN EXT: 7923
 CE GROUP:  33 DIGITAL GROUP
DOCUMENT AVAILABLE REPROGRAPHICS        REVISION LETTER: B
```

Figure 2

```
     CURRENT  PURCHASED ITEM SOURCE LIST (PISL) FOR PART 152-0066-01
BUYER: 38 -STUCKI KEN EXT: 7923                          R          A
CE ENGR: 12-ANALOG GROUP                                 A          C
                        DRAWING TYPE DESIGNATION         T          T
                      SOURCE CONTROL DRAWING             I          I
 DATE:  76/07/29.                          FEDERAL       N    EFF.  O
 MANUFACTURER//MANUFACTURER"S P/N           CODE         G    DATE  N

GENERAL INSTRUMENT CORP                    14936         A  76/07/23.
SEMICONDUCTOR PRODUCTS GROUP
          GIG-002

ITT SEMICONDUCTORS                         14433         A  76/07/23.
          EM5175

SEMTECH CORP                               14099         A  76/07/23.
          S4M


    ---EXPLANATIONS AND COMMENTS---
B REV
                                                        PAGE 1
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The Component Information System (CIS) provides a wide range of data about purchased components used in Tektronix products. Figure 1 is a sample display of a block of data providing general information about each purchased component. Figure 2 is a sample display of a second block of data providing Purchased Item Source List (PISL) information.

the data base which meet the criteria you specify. It then permits you to DISPLAY the general information or the PISL information for any component you select by the FIND command. Selection criteria include:

- Tektronix part number,
- manufacturer's part number, and
- manufacturer's federal code.

Using the data stored in the system, you can answer the following kinds of questions:

- Is a part single-sourced or source-controlled?
- Who are the approved manufacturers for the part?
- Is the part currently used in production?
- What parts can we buy from a specific manufacturer?
- What is the Tektronix part number or numbers which correspond to a specific manufacturer's part number?

These questions represent a small subset of the information which the user can derive from the system.

FUTURE CAPABILITIES

As the data base evolves, the Component Information Group will add additional blocks of information about each component. These blocks will include:

- Functional parameters similar to those now published in parts catalogs.
- Product certification information identifying controlled components in certified products. (A **controlled component** cannot be changed without approval of the certifying agency.)
- Summarized reliability and quality data.
- Miscellaneous codes and comments, many of which will be used to store recommendations and problem information about components.

As the Component Information Group adds new categories of information to the data base, they will develop additional queries which allow selection and display of component data records based on the above information.

In the future, a series of processing programs and a general-query capability will be available to support a variety of uses for the component data. These uses include:

- Selecting, displaying, and printing data.
- Checking new product parts lists to identify problem components.
- Generating source information for parts lists to be published in manuals and provisioning lists.
- Monitoring controlled parts to avoid inadvertent changes.
- Tracking problem parts.
- Generating catalogs.

FOR MORE INFORMATION

If you have questions about the Component Information System and its future development plans, contact Harriet Krauss (d.s. 58-299, ext. 4710-Beaverton) or Kris Leite (d.s. 58-299, ext. 6512-Beaverton). They would be pleased to provide additional information or demonstrate the system. □

technical standards

To borrow or order copies of standards, call ext. 241 (Town Center).

Tektronix Standard 062-3742-00, **Energy Management Standard, Lighting,** is not to be confused with 062-3744-00, **Illumination, Minimum,** which Technical Standards withdrew on 27 April 78. The Energy Management standard is current and valid.

NEW STANDARDS

Calibration and Related Measurement Services of the National Bureau of Standards; NBS Publication 250.

Standard Test Methods for **Passive Electronic Component Parts;** EIA-RS-186-E.

Multiple Controllers in a **CAMAC Crate;** IEEE STD-675-1979.

Electrical Interface Between Numerical Control and Machine Tools; EIA-RS-431.

Revision Pages for **Cord Sets and Power Supply Cords,** Seventh Edition; UL-817.

Cable, Power, Electrical: **Ignition, High-Tension;** MIL-C-3702A.

Dimensional and Electrical Characteristics Defining **Dual In-Line Lead Socket Panels;** EIA-RS-444.

Character Set and Print Quality for **Optical Character Recognition;** ANSI X3.17-1977.

For Paper Used in **Optical Character Recognition** Systems; ANSI X3.62-1979.

Representatives for U.S. Customary, SI, and Other Units to be Used in Systems With **Limited Character Sets;** ANSI X3.50-1976.

Guide for **Field Testing** Power Apparatus Insulation; IEEE STD-62-1979

Studs, Aluminum Alloy for Stored Energy (Capacitor Discharge) Arc Welding; MIL-S-24149/5A.

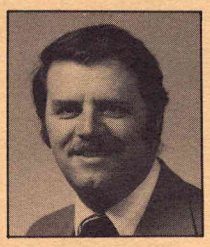
General Specifications for **Connectors, Electrical, Modular, and Component Parts;** MIL-C-28754B.

Notice 2, General Requirements for **Electronic Equipment;** MIL-STD-454F.

Standard for **Power Supplies,** Second Edition; UL-1012.

Continued on page 15

PRODUCT SAFETY HIGHLIGHTS REQUIREMENTS



Pete Perkins, Product Safety/Technical Standards, ext. 256 (Town Center).

Eddie Richmond, Product Safety, ext. 258 (Town Center).

Product Safety, part of Standards/Maintenance Support, evaluates Tektronix' products for:

- **protection of people and property,**
- **standards compliance,**
- **compliance with government requirements, and**
- **liability prevention.**

Product Safety does this by examining each design's

- **enclosure,**
- **ventilation,**
- **interior structures,**
- **components, and**
- **circuits.**

This article addresses the requirements most commonly discussed between product safety engineers and design engineers.

Product Safety, in evaluating a product, attempts to minimize the possibility of physical injury, shock, emanations, fire, and implosion hazards during intended use and foreseeable misuse of a product. Product Safety does this by investigating the degree of protection the design affords.

To meet Underwriter's Laboratory (UL), Canadian Standards Association (CSA), and International Electrotechnical Commission (IEC) standards, and the standards peculiar to particular countries, design engineers should communicate with the Product Safety (PS) group during design development. Table 1 lists standards widely used at Tektronix.

The following information describes several items PS examines and checks for.

ENCLOSURE

A product enclosure includes exposed components, operator-accessible parts, crt face and implosion shield, and internal supports. PS engineers examine the enclosure to ensure that it provides protection against (1) property damage and (2) shock or injury resulting from foreseeable mechanical abuse of the product.

The check includes such tests as shake, shock, and 5-foot-pound impact on surfaces (including the implosion shield). Tests also include a pressure test — for example, 20 pounds applied to surfaces via a half-inch-diameter rod with a hemispherical end.

With rare exceptions, ungrounded exterior conductive parts must not carry voltages exceeding 30 volts rms, 42.4 peak or 42.4 volts dc (even if a knob comes off the shaft). Grounded external parts must handle (for one minute) 25 amperes rms fault-current to protective ground with resistance not more than 0.1 ohm.

An externally accessible fuse holder must prevent operator contact with its metal parts. Fuse holder power input must connect only to the most interior metal part of the fuse holder.

External or internal fuses providing fire protection require clearly prescribed markings. Markings must state the need to (1) disconnect power when replacing fuses and (2) replace the fuse only with one of a specified type and rating.

To prevent operator access to the equipment interior, PS requires adequate instructions and mechanical provisions. For service personnel, Tektronix provides appropriate warnings inside its products.

VENTILATION

UL, CSA, and IEC ventilation standards are stringent.

For top holes in test-and-measurement products, a 4-millimeter by 100-millimeter rod, when inserted through a top hole, must not touch a live part.

For office machines and data-processing equipment, different top-hole requirements apply: when inserted (if possible) through a hole, neither of the two IEC-defined test fingers must be able to touch a live part. In this test, PS inserts the jointed finger in every possible direction, and also inserts the rigid test finger with a maximum force of 30 newtons (6.744 pounds) in every possible direction. Further, the distance of approach of either test finger to an uninsulated primary part must be at least 3 millimeters. To prevent entry of fluids, consider louvering, guarding, or baffling.

For all products, holes in the front, back, sides, and bottom must meet the requirements stated above for top holes in office machines and data-processing equipment. The standards prohibit top holes in medical products.

Further, the standards require a barrier between electromagnetic components (such as transformers, motors, and relays) and bottom holes of any product. The barrier must either be (1) a galvanized metal screen having 14-by-14-per-inch mesh and 0.018-inch-diameter wire or (2) made according to table 2.

Use	UL Standards	CSA Standards	IEC Standards
Test and Measurement Products	1244	556B	348
Electronic Data-Processing Products	478	154	435
Office Equipment	114	154	380
Medical Equipment	544	125	601

Table 1. UL, CSA, and IEC standards most widely used at Tektronix.

ACCEPTABLE PERFORATED METAL PLATES

Nominal Thickness Inch/Millimeter	Minimum Thickness Inch/Millimeter	Maximum Diameter of Holes Inch/Millimeter	Minimum Spacing of Holes Center to Center Inch/Millimeter
0.030/0.76	0.026/0.66	0.045/1.14	0.067/1.70 (233 holes per sq. in. or 645 sq. millimeters)
0.030/0.76	0.026/0.66	3/64 (0.047)/1.19	3/32 (0.093)/2.36
0.035/0.89	0.032/0.81	0.075/1.91	1/8 (0.125)/3.18 (72 holes per sq. in. or 645 sq. millimeters)
0.040/1.02	0.036/0.91	1/16 (0.063)/1.60	7/64 (0.109)/2.77
0.040/1.02	0.036/0.91	5/64 (0.078)/1.98	1/8 (0.125)/3.18

Table 2. Specifications for required barriers between electromagnetic components and bottom holes of all products.

In the absence of the barrier described above, the product must pass either the CSA flaming-oil test or the CSA molten PVC-copper test.

INTERIOR STRUCTURES

As defined below, product design must provide adequate ventilation.

Support components, including electrical components and assemblies, must prevent fire and shock hazards. To maintain adequate distance, electrical assemblies must have specified clearances and creepage distances as well as mechanical strength.

The arrangement of components must maintain adequate spacings between hazardous and nonhazardous circuits. For example, spacing between primary conductors, and between primary and other conductors, must be at least 3 millimeters for a 250-volt potential. High-efficiency power supplies may require greater distances. In addition, these requirements apply to circuit-board runs and component spacings.

COMPONENTS

In hazardous circuits, tests of active components and of electrolytic capacitors must verify fail-safe operation. Nothing should impede electrolytic-capacitor venting.

To assure adequate protection, PS tests components and materials separating primary from secondary and other circuits. Examples of such materials include insulation in transformers and radio frequency interference filter capacitors. In addition, PS checks clearances and creepage distances.

Components that limit hazardous inputs receive reliability checks including open- and short-circuit checks.

CIRCUITS

If the power cord is yanked out, the power-cord protective-ground conductor must be the last component to fail. This requirement means the protective-grounding conductor of an attached power cord must have more internal slack greater than any other conductor in the power cord. At Tektronix, engineers' purchase orders often specify a minimum of 3/8-inch excessive protective-ground-conductor length; but remember: merely making the protective-grounding wire the longest wire does not necessarily do the job. Be sure this wire has the greatest slack.

Primary components, such as power switches, fuse holders, and voltage-setting devices, must have suitable UL, CSA, and appropriate foreign certification markings — or receive extensive additional testing. Certifications must be satisfactory for the application and for the market intended. A "mu" symbol on a switch means the internal spacings are not sufficient for primary voltages.

PS investigates "limited" circuits less stringently. A test-and-measurement limited circuit delivers not more than 150 watts to an external resistor connected across the load. A medical-product limited circuit (on a circuit board) delivers not more than 50 watts for more than one minute to an external resistor connected between any two points on the circuit. An office-machine or data-processing limited circuit keeps the current below eight amperes for one minute (the circuit might need a fuse as low as three amps!).

Office-machine and data-processing secondary circuits supplied by 200-volt-ampere or higher capacities at more than 100 volts must use primary-circuits spacing levels.

In production, Tektronix must test every unit for (1) protective-ground continuity all the way from the chassis to the power-plug ground pin, and (2) the primary circuit's ability to withstand 1,500 volts rms to ground with the power switch ON (some products must withstand more).

TEMPERATURE

A test-and-measurement or medical device must meet its temperature requirements even when against a wall, in a corner, or in an alcove. Feet may have to be removed during the test.

Rack-mount test-and-measurement equipment must meet temperature requirements in a wooden box with 2-inch clearance all around, with front or back (or both) openings as needed for control and cables.

PRECAUTIONS

All products must include sensible safety devices and precautions. This requirement includes appropriate fusings, implosion shielding, interlocks where applicable, and other precautions.

FOR MORE INFORMATION

For more information, contact Product Safety engineer Eddie Richmond at ext. 258 (Town Center) or d.s. 41-400. □

ENGINEERS OFFERED BETTER PRODUCT PLANNING AID

MSSCRAVI: An acronym formed using the following formula:

MS = Material Screening (the data base name)
SCR = Screening (the data base application)
AVI = Available Inquiry (the data base function)

MSSCRAVU: An acronym formed using the following formula:

MS = Material Screening (the data base name)
SCR = Screening (the data base application)
AVU = Availability Update (the data base function)

MSSCRAVI

Design engineers can now readily access parts availability information through MSSCRAVI, a program that accesses a new material screening data base system. MSSCRAVI improves product planning by providing detailed up-to-date demand, order, and availability information for any Tektronix part.

The material screening data base system replaces an old system (SCSCRAVL) that provided similar information, but offered less help to engineers. The increased information included in the new system makes material availability information more reliable and complete. Because of the assurance of accurate information, NPI Logistics can now confidently encourage engineers to use this new system.

CORPORATE-WIDE APPLICATIONS

MSSCRAVI, an inquiry-only data base information program, provides numerous benefits for many groups at Tektronix. Major benefits include (1) on-line inquiry,(2) accessible inventory control data showing weekly detailed material availability information for the next 13 accounting periods, (3) ability to handle high volumes of inquiries simultaneously, and (4) easy use and assured accurate information.

The material screening data base system aids:

- **Manufacturing** (Material Screening Department) in allocating material requisitions and planning Bill of Material changes.
- **Marketing** (Customer Service Department) in providing more efficient planning and delivery of replacement parts for customer and factory service.
- **Engineering** in viewing and determining availability of Tektronix-made or purchased parts for effective part selection.

ENGINEERING APPLICATIONS

MSSCRAVI specifically benefits engineers by enabling them to:

- choose prototype parts immediately available,

Engineers can access MSSCRAVI, a new material screening data base system, through IBM 3277 IMS terminals. Shown here with an IMS terminal are Brad Jeffries *(left)* and Terry Smith.

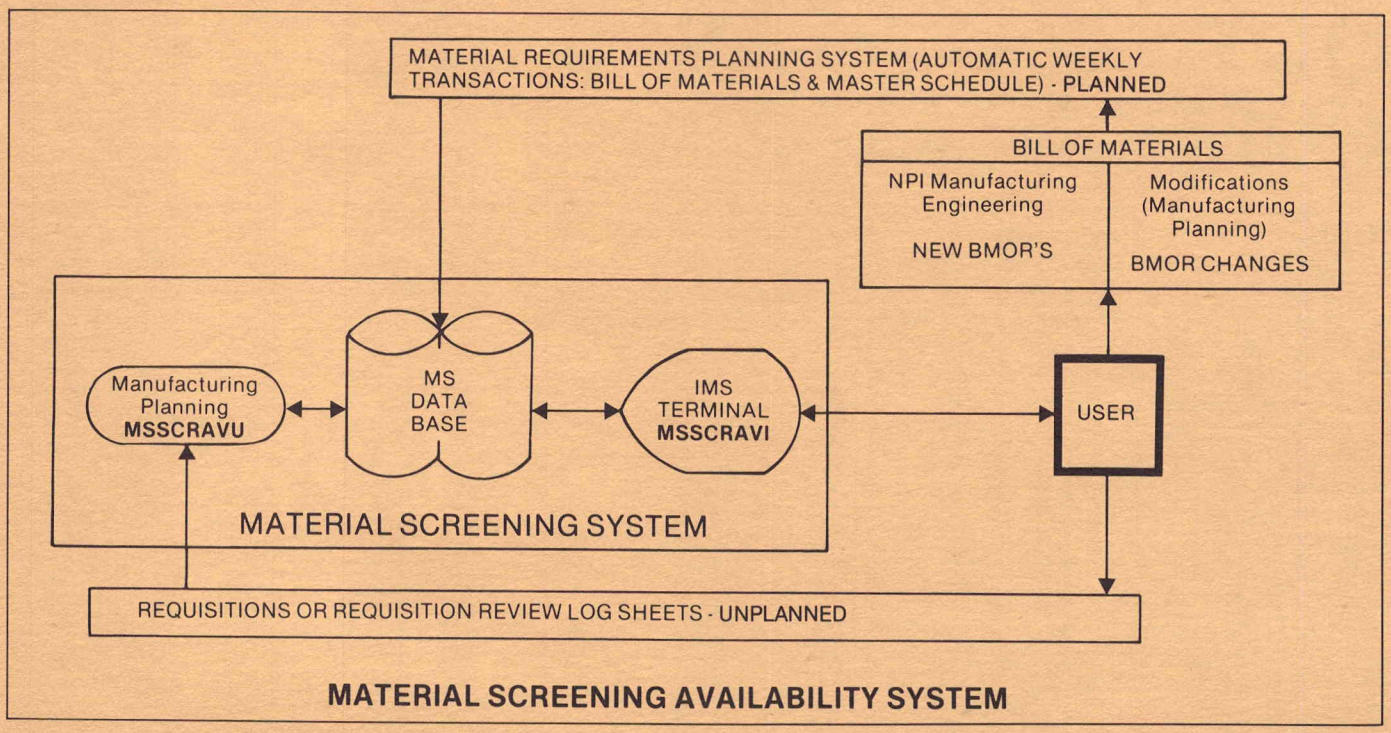
- determine if quantities on hand and on order will meet engineering and production requirements,
- identify the procurement lead time for a particular part not currently available,
- substitute (when possible) components on hand for those not readily available,
- identify specific buyer or scheduler to discuss part availability, and
- identify **critical code** parts (parts which have such problems as procurement, quality, performance, and yield) — this feature will be added in the near future.

For example, as an engineer, you may want to investigate the availability of parts you are considering for a new product. MSSCRAVI lets you find out if those components are immediately available or, if they are not now available, how long it will take to procure them. MSSCRAVI displays data that will aid you in selecting material for such needs as engineering models, A- and B-phase builds, and first production builds.

Use of this system should significantly shorten the New Product Introduction (NPI) process as a whole by enabling engineers to identify material availability problems early...resulting in faster turnaround in acquiring materials.

MSSCRAVU

MSSCRAVU, a second interactive program which allocates material, keeps MSSCRAVI up-to-date. MSSCRAVU's use is limited to the Manufacturing Planning Groups who process requisition forms and Requisition Review Log Sheets. Each requisition processed on MSSCRAVU automatically and immediately updates the information



MATERIAL SCREENING AVAILABILITY SYSTEM

Design engineers can now readily access parts availability information through a material screening system. MSSCRAVI is a program on the system that enables engineering users to access Material Screening, the material availability data base. MSSCRAVI displays help engineers make decisions about parts availability for prototypes and final products.

Refer to the flow chart above. Manufacturing Planning, using MSSCRAVU (an update and allocating program), inputs new data into the Material Screening data base. A user examines the MSSCRAVI data displays (on an IMS terminal) and either (1) fills out a requisition form or Requisition Review Log Sheet and sends it to Manufacturing Planning, or (2) fills out a BMOR (Bill of Materials) and sends it to NPI Manufacturing Engineering (new BMOR's) or to the Modification group in Manufacturing Planning (BMOR changes).

Manufacturing Planning, using MSSCRAVU, inputs the part-request data into the Material Screening data base which immediately updates the information displayed on MSSCRAVI. Each week, business unit schedulers generate Bills of Material and Master Schedule changes which are automatically processed (weekly) into the Material Screening data base. The result is up-to-the-minute display of material availability information for MSSCRAVI users.

displayed on MSSCRAVI. Overallocation is essentially impossible because the display on MSSCRAVI is always up-to-date, accurate, and ready for the next inquiry.

HOW THE SYSTEM WORKS

Basically, the material screening system works as follows:

- Manufacturing Planning inputs part requisition requirements (12,000 to 15,000 transactions per week) into MSSCRAVU.
- The data base system processes each entry immediately and combines it with all other corporate demand data.
- Users then view the updated data on an IMS terminal.

(See Material Screening Availability System flow chart.)

IMS TERMINALS

MSSCRAVI resides on the IBM 3033 computer in building 55; users access MSSCRAVI through IBM 3277 IMS terminals located throughout Tektronix' Portland-area locations. The terminals are off-white in color, have a 15-inch display, and have a detached keyboard. With the new system, terminal use has nearly tripled, handling approximately 100,000 inquiries per accounting period.

FOR MORE INFORMATION

For more information, contact Terry Smith, New Product Introduction Logistics, ext. 5200 (Beaverton). For a handbook on how to use the material availability data base system, contact Brad Jeffries, Systems Development, ext. 5696 (Beaverton). □

OCTOBER PAPERS AND PRESENTATIONS

While providing recognition for Tektronix engineers and scientists, the presentation of papers and the publication of papers and articles contribute to Tektronix' technological leadership image.

The table below is a list of papers published and presentations given during October 1979.

The Technical Communications Services' (TCS) Engineering Support group's charter is (1) to provide editorial and graphic assistance to Tektronix engineers and scientists for papers and articles presented or published outside Tektronix and (2) to obtain patent and confidentiality reviews as required.

If you plan to submit an abstract, outline, or manuscript to a conference committee or publication editor, take advantage of the services that TCS Engineering Support offers. Call Eleanor McElwee on ext. 8924 (Merlo Road). □

TITLE	AUTHOR	PUBLISHED	PRESENTED
SOFTWARE:			
☐ "Managing the Development of a Universal Computerized Standard Data System"	Jim Lushina	**MTM Journal**	University of Wisconsin
HARDWARE:			
☐ "An Empirical Approach to Projection Lithography"	Delmer Fehrs	**Conference Record**	Kodak Interface Conference
☐ "A Comparison of Low-Frequency RC Oscillator Topologies"	Bruce Hofer	**AES Preprints**	Audio Engineering Society
☐ "Separation and Distortion Measurements on Quadraphonic Decoders"	Richard Cabot	**AES Preprints**	Audio Engineering Society
☐ "Acoustic Applications of Cross-Correlation"	Richard Cabot	**AES Preprints**	Audio Engineering Society
☐ "Hysteresis and Transition Processes in Dye-Doped Cholesteric Nematic Phase Change System"	Catherine Lin-Hendel	—	Electrochemical Society
PROCESS ENGINEERING			
☐ "Transfer Molding High-Voltage Transformers on Lead Frames Improves Reliability, Economy, and Design Flexibility"	Bob Cogan and Tom Morisky	**Conference Record**	Electronic Insulation Conference
MATERIALS RESEARCH:			
☐ "Gettering Studies on Oxidation and Epitaxial Defects for Diffused and Implanted Buried-Layer Processes"	James Topich	—	Electrochemical Society

For a copy of a paper or article listed here, photocopy this table, check the appropriate box, and mail to TCS, d.s. 53-077.

Continued from page 9

Electric Lighting Fixtures For Use in Hazardous Locations, May 1978; UL 844.

Resistor Networks — Fixed Film; EIA-RS-451.

Electroless Copper Film for **Additive Printed Boards;** IPC-AM-372.

Artwork Generation and **Measurement** Techniques; IPC-D-310A.

Line Conventions and Lettering; ANSI Y14.2M-1979.

10-Key Keyboard for Adding and Calculating Machines; ANSI X4.6-1979.

Acceptability of **Printed Boards;** IPC-A-600C.

Fixed Film Resistors — High Resistance/High Voltage; EIA-RS-452.

Printed Board, Rigid, Single- and Double-Sided; End Product Specification; IPC-D-320.

Printed Board Description in Digital Form; IPC-D-350B.

Graphic Symbols for **Fluid Power Diagrams;** ANSI Y32.10-1967.

Start-Stop Signal Quality Between Data Terminal Equipment and Non-Synchronous Data Communication Equipment; EIA-RS-404.

Advanced Data Communication Control Procedures (ADCCP); ANSI X3.66-1979.

Structure for **Formatting Message Headings** for Information Interchange Using the American National Standard Code for Information Interchange; ANSI X3.57-1977.

The **International System of Units** (SI), 1977; NBS Publication 330.

Weights and Measures Standards of the United States, a brief history; NBS Publication 447.

Occupations in Electronic Computing Systems, 1972; Department of Labor.

Brief History of **Measurement Systems,** with a chart of the Modernized Metric System; U.S. Department of Commerce.

Electrical and Electronic **Measuring and Testing — First Edition Equipment,** July 1978; UL 1244.

Thin Copper Foil for **Printed Wiring** Applications; IPC-CF-155.

Qualification and Performance of **Permanent Polymer Coating** (Solder Mask) for Printed Boards, 1978; ANSI/IPC-SM-840.

General Specification for 1/8-inch Diameter Shank **Carbide Drills** for Printed Boards; IPC-DR-570.

Technology Utilization — **Computer Programs:** Special Applications; NASA SP-5967.

A Modular Instrumentation System for **Data Handling** — Specification of Amplitude Analogue Signals Within a 50-ohm System; CAMAC.

Commonly Used Terms in the **Steel and Nonferrous** Industries; **Iron Age,** Handbook of Terms.

The International Bureau of **Weights and Measures** 1875 - 1975; NBS Publication 420.

Automatic Data Processing Glossary, Dictionary of **Data Processing** Words; Superintendent of Documents.

Safety Color Code for Marking **Physical Hazards;** ANSI Z53.1-1979.

Character Structure and Character Parity Sense for **Parallel-by-Bit Data Communication** in the American National Standard Code for Information Interchange; ANSI X3.25-1976.

Minimal **BASIC;** ANSI X3.60-1978.

Programming Language **FORTRAN;** ANSI X3.9-1978.

Flowchart Symbols and Their Usage in Information Processing; ANSI X3.5-1970.

Subminiature Sensitive Switches; EIA-RS-437.3.

Sub-Subminiature Sensitive Switches; EIA-RS-437.4

Continued on page 16

Technology Report

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Small Contact Standard for **Electrical Connectors;** EIA-RS-380-A.

Gage Blanks (Metric Translation of ANSI B47.1-1974); ANSI B47.1A-1978.

Fixed Capacitors for Use in Electronic Equipment, Terminology, and Methods of Test (with supplements); IEC 384-1-1972.

Amendment 1978, Guide to **Calculation of Resistance** of Plain and Tinned Copper Conductors and Low-Frequency Cables and Wires; IEC 344-1971.

Standard Colors for **PVC Insulation** for Low Frequency Cables and Wires; IEC 304-1978.

High Voltage Fuses; IEC 282-1A-1978.

Dimensional Tolerances for **Aluminum Mill Products;** ANSI H35.2(M)-1978.

Mechanical Standardization of **Semiconductor Devices,** Part 2, Dimensions; IEC 191-2H-1978.

Mechanical Standardization of **Semiconductor Devices,** Part 3, General rules for the preparation of outline drawings of integrated circuits; IEC 191-3B-1978.

Graphic Representation of the **Control Characters** of American National Standard Code for Information Interchange; ANSI X3.32-1973.

Code for **Information Interchange;** ANSI X3.4-1977. □

Scratch Area

WANT TO REACH TR READERS?

A continuing feature of **Technology Report** is the *Scratch Area* column. This space is set aside for miscellaneous short notices such as new personnel introductions, calls for information, and calls for papers. To contribute to *Scratch Area,* send your input to the associate editor, Laura Lane, at d.s. 53-077 (ext. 8927-Merlo Road). □