component news

May 5, 1981 COMPANY CONFIDENTIAL Issue 288

Two new operating systems for the board bucket

About a year ago, *Component News* ran an article entitled "Poor Man's Disk Operating System" (see issue 278, pages 1-3). The article described the FLEX 2 software (for the M6800 processor) written by Technical Systems Consultants. Since that time, two more types of microprocessors have been supported by disk software, and this has opened up a large amount of existing software to users of the "board bucket."

FLEX 09

The first new MPU to be supported is the 6809. The software is again supplied by Technical Systems Consultants and is very similar to FLEX 2. It is called FLEX 09 and includes an editor and assembler just as FLEX 2 does. The disk system needed is the same one previously described, but the memory map differs considerably. The following table gives the new memory map.

Address	Usage
0000-BFFF	User RAM
C000-DFFF	DOS
E004-E005	Terminal ACIA
E006-E007	CYBER port
E010-E013	Printer spooler (timer)
E014-E01B	Disk controller
E118-E11B	DDT break points
E400-E7FF	DDT RAM
E800-FFFF	DDT ROM

Upon close inspection, it can be seen that the standard Tek board bucket cannot address these locations without cutting some runs on a number of the boards.

With this system in mind, a new Disk Controller board was designed which solves the problems with the address map. This new board (CSC board number E7901) contains the disk controller, breakpoints, printer spooler and bootstrap ROM. It is a low-profile board with all of the space used. It is intended to be used with the 65K RAM board (E7599) and either an Octoport (E6227) or the new I/O and Breakpoint board (E7850). The breakpoints work the same as before. The printer spooler is a PIA with a 5009 timer chip connected to one half. It provides the interrupts for printing while running some other program.

The disk controller works much as before, except the addressing is now set by changing the straps on the board rather than changing diodes. The bootstrap ROM is new and can be addressed anywhere in the address space to boot-up the system.

When the system is up, a write can be done to the FFFx location and the ROM shuts off. This allows a full 65K to be used for addressing RAM or other devices. The typical way this is used is to set the ROM at the high end of memory to cover the restart vectors. The exact location would depend on the ROM used.

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Also in this issue

The E7901 Disk Controller board supports the 2716, 2732 and 2764 PROMs. On power-up the restart vector points to a routine which copies the ROM into RAM, writes into FFFx to shut off the ROM, and then loads in the first sector of the disk. The standard boot-up procedure continues from there. The E7901 board, as well as all other board bucket components, are available from the Computer Science Center (ext. WR-1920).

FLEX 09 can be purchased from Technical Systems Consultants, Inc. at Box 2570, W. Lafayette, IN 47906. The DDT6809 is on CYBER user number ABOOMIC under file name DDTV21B, and can be down-loaded and burned into PROM.

CP/M 2.2

The second operating system supports more than one MPU. It was written for the 8080 but can be run on the 8085 or the Z80. The software was originally written by Digital Research, and is called CP/M 2.2. This is one of the most widely used disk-based packages for microprocessor systems. There are about 50 volumes of public-domain software which can be obtained to run under this system.

Implementation on the board bucket was not an easy job. The DDT software which is usually used is located at address 0. CP/M 2.2 requires that there be RAM located at 0. This meant that the DDT had to be relocated to the high end of memory, and the new disk board was used so that the bootstrap ROM could be put at the bottom to cover the restart vectors and then be shut off after a jump was made to DDT.

CP/M 2.2 requires a minimum of 20K of RAM starting at zero. It can then relocate itself to any size system. The software for the DOS comes in three parts — the Command Control Processor (CCP), Basic Disk Operating System (BDOS), and the Basic Input Output System (BIOS). To adapt this software to a new system the BIOS needs to be rewritten. It can then be assembled for any size memory space. Two other programs need to be written also. They are FORMAT, which makes a blank disk into one that CP/M 2.2 can use, and SYSGEN, which takes a memory image of a new system and places it on the first three tracks.

The memory map is given in the following table.

Address	**Usage**
0000-DB00	RAM (minimum 20K)
DB10-DB11	Terminal I/O port
DB20-DB21	CYBER port
D814-D818	Disk controller
DA18-DA19	DDT breakpoints
DC00-DFFF	DDT system RAM
E800-FFFF	DDT85V2.0 (optional)

CP/M 2.2 can be purchased on 5¼-inch disks from Jade Computer Products at 4901 Rosecrans, Hawthorne, CA 90250. The order number is SFC-52506000M. The DDT85V2.0 is located on CYBER user number ABOOMIC under file name DDT85V2, and can be down-loaded and burned into PROM.

After purchasing a copy of the CP/M 2.2, a system will have to be created by adding the BIOS that I have written. The software is serialized in a way so each copy is unique. This means that the software from the new disk must be loaded into RAM with the BIOS and saved onto a new disk.

If you plan to bring up a system of this type, please give me a call on ext. DR-2572.

Wilton Hart
Digital Component Engineering

A new book about an "old friend"

In 1974, engineers in the Information Display Division needed a microprocessor development system to exercise the M6800 — the heart of the 4051 Graphic System then under development. In response to this need, they created a system that affectionately became known as the "board bucket."

Other Tek engineering groups soon realized its value and began designing new bus-compatible memory, I/O, data acquisition and processor boards. Eventually, engineering support of the board bucket was placed under the auspices of the Computer Science Center (CSC) Microprocessor Support Group.

While the ubiquitous board bucket has proven its worth on numerous projects, it has lacked adequate documentation for the new engineer. To remedy this, the CSC Technical Commmunications group is publishing the **Microprocessor User's Guide.** The guide, written by Cliff Morgan, provides photos and functional descriptions of the primary bucket boards, and discusses some important software development tools. There is also a chapter providing "hands on" programming experience, both in TESLA as well as in assembly language. Finally there is a section listing classes, textbooks, tutors and other information sources.

Copies of this guide are available though the CSC librarian (Georgene Kayfes, ext. 6870), or through the CYBER MANUAL program.

AMP redesigns edgecard connectors

AMP, Inc. has announced plans to change the design of their "Standard Edge" edgecard connector line. These alterations will affect 11 Tek part numbers, as shown in Figure 1. The changes are twofold — purely cosmetic changes in color (from gray to black in some cases), and a major redesign of the contact spring. External dimensions are unaffected.

Tek P/N	AMP P/N
131-2580-00	530843-5
131-2579-00	530843-9
131-2029-00	530363-8
131-2682-00	3-530396-2
131-2491-00	1-530843-8
131-2492-00	1-530843-2
131-2494-00	1-539843-6
131-2493-00	2-530843-2
131-2570-00	2-530843-2
131-2352-00	1-530843-6
131-2351-00	2-530843-0

Figure 1

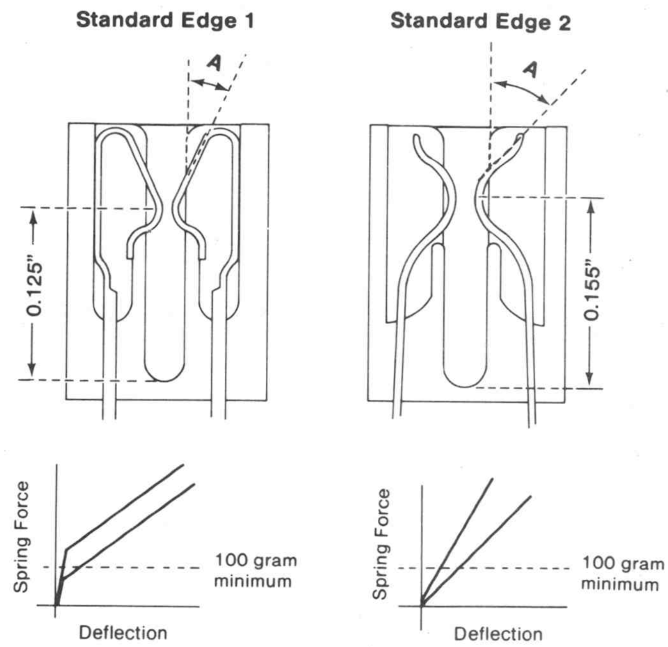

Figure 2

The spring for Standard Edge I (the current design) is shown in Figure 2 to be preloaded against the housing. This preload is evidenced by the sharp initial rise in spring force exceeding the minimum 100 grams with only 0.002" deflection. Ensuring consistent deflection, preloading also provides a convenient means for controlling the gap between springs from one row to the next. Samples measured ranged from 0.016" to 0.018" between springs.

The proposed spring for Standard Edge II is a cantilever (see Figure 2). The absence of preload in this design necessitates 0.007" (nom.) of deflection in order to provide 100 grams of force. Because the same housing is used for this new design, the preload barrier serves only to prevent shorting between adjacent contacts. The maximum gap between springs, however, is uncontrolled and has been measured to range from 0.028" to 0.032". Furthermore, the contact point has moved up from 0.125" in Standard Edge I to 0.155" in Standard Edge II.

The manufacturer has assured us that only minor internal housing dimension changes were made in order to accommodate the new spring. Overall length, width, tail length, etc. should remain unaffected.

Two concerns evolved after studying this system — the possibility of spring crushing, and the sufficiency of spring force under worst-case conditions. Experience has demonstrated that cantilever beams are particularly susceptible to crushing by PCB edges which are only marginally well rolled or beveled. This arises from the more nearly obtuse entrance angle (A) presented by the spring to the PCB upon mating. The result is a spring crushed down to the bottom of the connector housing. So far, AMP's design has demonstrated immunity to this type of damage.

To allay concern associated with the second problem mentioned, Component Engineering cycled warped boards, 0.058" thick, through various mate/unmate cycles using Standard Edge I and II. Low level contact resistance was monitored before and after environmental stressing (standard humidity/sulfide environment followed by aging) in an attempt to gauge the integrity of the connection.

The bow in the PCB causes springs in the center of one row to undergo large deflection (0.030"), while adjacent springs (in the opposite row) may only deflect 0.004". Under these conditions, Standard Edge I provides only 60 grams normal force

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whereas Standard Edge II provides between 80 and 120 grams. Though Standard Edge II did demonstrate greater instability in contact resistance, the difference in performance was not sufficient to disqualify AMP's new design.

AMP's primary motivation for making the change is to reduce the cost of their product by more careful deposition of gold plating, reduction in spring material and increase in assembly automation. A second benefit is the reduction of insertion/withdrawl forces by about 20%.

For more information, test procedures or results, please contact **Joe Reshey (ext. DR-2313).**

Bare copper power transistors require attention

Motorola, one of our more important power transistor vendors, has just changed the packaging process and materials for TO-126, TO-127 and TO-220 power transistors. This change affects all TO-126 and TO-127 and most of the TO-220 packaged devices used at Tektronix. This does not apply to three-terminal regulators, SCRs or triacs.

The change is two-fold:

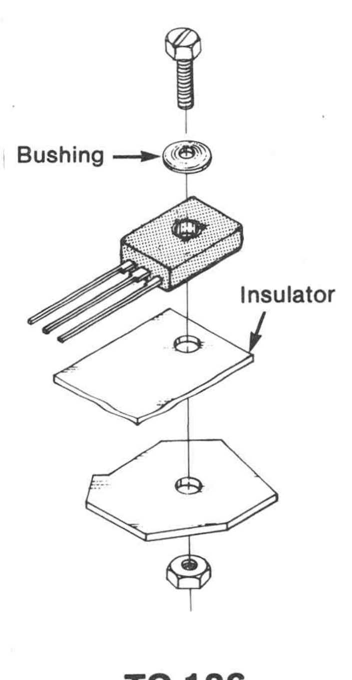
1. The plastic is changed from a silicone compound to an epoxy material, and
2. The headers are changed from gold- or nickel-plated copper to *bare copper only*.

Motorola's rationale for these changes was to dramatically improve the power-cycling ability of their product, and to provide much higher resistance to environmentally-caused internal degradation.

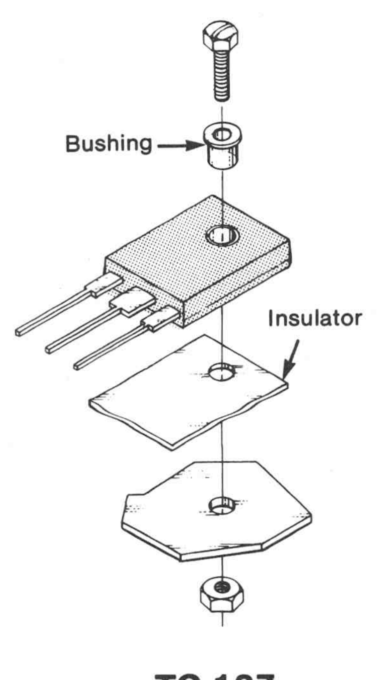
Tek's only reservation concerning this change was the exposed copper on the tab and mounting surface. Copper corrodes when it is in intimate contact with other metals. However, this situation can be greatly minimized by installing common plastic power transistor insulation hardware, assuming the insulator and bushing are not already specified for electrical isolation.

Some typical examples of this installation technique are shown below.

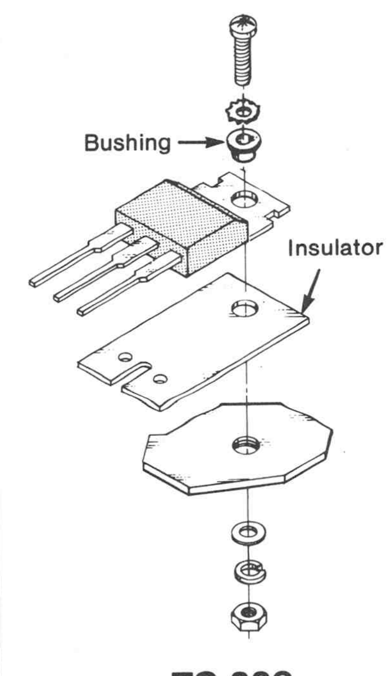
If you have any questions, please contact **Jim Williamson, ext. DR-2552.**



TO-126



TO-127



TO-220

SSI/MSI Digital IC

Quality and reliability project status report

In mid-1979, Steve Swerling was asked to develop a standardized approach to component quality for SSI/MSI digital microcircuits. Steve formed a task group with representatives of Central Manufacturing, Technical Support and all division manufacturing managers.

The goals of this task group were to set one "Plant Quality Level" company-wide for SSI/MSI digital ICs, and to set up an effective communication path between test engineering groups and the divisions.

After investigating the mid-1979 status of the SSI/MSI part usage at Tek, we found that:

- ☐ Parts were being purchased to a 0.65% AQL (acceptable quality level).
- ☐ Defect levels experienced in plants were from 0.2% to 1.5%.
- ☐ 7.5 million SSI/MSI parts were being bought annually (about 1500 lots); average part cost, 38¢.
- ☐ About 480 base (-00) part numbers and 800 dash numbers for test or selection existed.
- ☐ About 4 million parts were being tested annually on a comparison-type tester at Component Preconditioning and test.
- ☐ Returning reject lots was difficult due to correlation problems and inventory status.

The task group considered the economic impact of various quality levels and selected a 0.1% AQL purchased from vendors directly (as opposed to the 0.1% AQL by in-house testing or by use of an independent test lab).

At this point, Component Reliability Engineering recommended that the group consider specifying the reliability level as well as the quality level. Three more alternatives were analyzed (see Figure 1). While alternative 3 appears to be about 5% more costly (at $200/field removal), it was determined that the advantages of high-reliability parts (Figure 2) outweighed the cost increase. These advantages, plus the difficulty in calculating the actual cost of unreliability, supported the decision of adopting alternative 3.

This agreement was then forwarded to Larry Mayhew in February 1980, for approval of the 0.1% AQL, 0.006%/1000 hour reliability level approach company-wide. Larry approved the plan, and asked Bill Polits to implement the 0.1% AQL, 0.006%/1000 hour approach throughout Tek.

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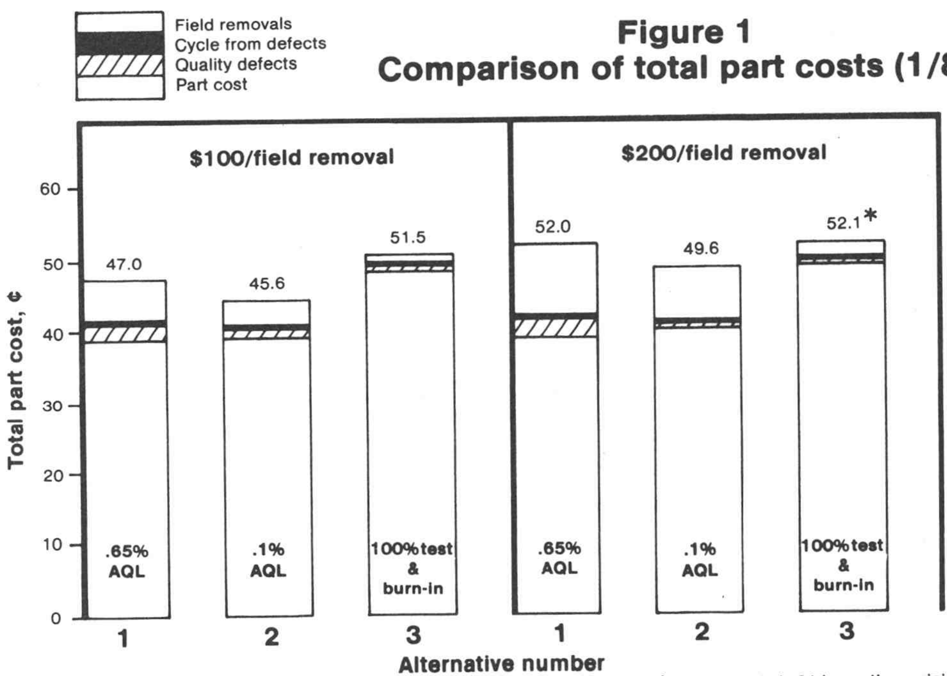
Figure 1
Comparison of total part costs (1/80)



* Current cost of this alternative is about 50¢ because the average cost adder for the 100% test and burn-in is 2¢ lower than originally estimated.

Inventory Reduction
Special parts stocks — Divisions
Factory service parts — Beaverton
WIP
Field service parts

Board Float Reduction
$10.4 million in US board inventory
Reducing float by $1 million is equivalent to spending 2¢/chip

Fewer System Burn-In Ovens

Increase Volume on Fewer Part Types

No Sockets

Customer Satisfaction

Slow the Increases In:
Personnel (field service, Beaverton)
Physical plant

Smoothness of Flow

Figure 2 — Advantages of high-reliability parts

Jim Brammer, Manufacturing Engineering Component Quality Control, was chosen to lead the project to implement this changeover. Areas addressed by the group included:

- ☐ Definition of SSI/MSI digital IC parts affected by the changeover.
- ☐ Purchase specification for high reliability parts (062-3919-00).
- ☐ Verification plan (for Incoming Inspection to assure quality and reliability of SSI/MSI parts).
- ☐ Procurement strategy.
- ☐ Nomenclature/modification process.

These areas were defined by late 1980, and are summarized in Figure 3.

Current status

The current status of the SSI/MSI digital IC project is:

- ☐ Parts lists for changeover priority have been identified — these were selected by considering annual usage, multiple sourcing and existence of test programs at Incoming Inspection. The first 100 part types affected by the changeover are listed in Figure 4.
- ☐ Purchase specification has been finalized (062-3919-00, rev. E).
- ☐ The verification plan has been finalized by Component Test Engineering and the acquisition of necessary test equipment (burn-in oven, humidity oven for life test monitor and temperature cycling chamber) is in the CCA process.
- ☐ Purchasing and Purchasing Planning have defined the purchasing approach.

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Parts Affected	ICs with digital inputs and outputs; 24 pins or fewer CMOS, TTL, LTTL, HTTL, STTL, LSTTL; Excludes: PROMs, microprocessors, MROMs, static memory over 64 bits
Purchase Specification	Established as technical sheet 062-3919-00, rev. E. Calls for 100% temperature cycling, burn-in and test
Verification Plan	Incoming inspection to 0.15% AQL for 70°C functional Reliability monitor tests on sample lots: operating life test, humidity bias life and extended temperature cycling Reliability monitor data required from vendors
Procurement Strategy	Support changeover to high reliability screened parts at schedule determined by planning and engineering change groups
Nomenclature and Engineering Change Process	Usage to be converted to dash number which represents the screened high-reliability part. Other part numbers (dash numbers) to be obsolete (see Figure 4)

Figure 3 — SSI/MSI project summary

- Modification (engineering change) process has started — the first 100 parts will be switched over to the high reliability part in AP205-206 and the last in 211-213.

New instrument project users of the screened part types report excellent quality and reliability results with many citing significant improvements over previous usage of -00 parts.

New projects should use the dash numbers for the screened parts listed in Figure 4. A complete listing of screened parts available can be found in the Semiconductor Parts Catalog, or on CYBER by accessing the HIREL program:

GET,HIREL = ACA0LAM
HIREL

This project has marked Tektronix' adoption of a specific process to achieve improved component quality and reliability. This approach is now being applied by Component Reliability Engineering to other categories of parts including memory micro-circuits, capacitors, high-voltage multipliers, transistors and diodes.

If you have any questions or comments, please contact me at 58-061, ext DR-1605.

Ron Schwartz
Component Reliability Engineering

Figure 4 — Change list for first 100 part types

From	Status	To	Status
156-0030-00	CR	156-0030-03	CR
156-0030-01	CR		
156-0030-02	CR		
156-0032-00	CR	156-0032-03	PP
156-0032-01	CR		
156-0032-02	CR		
156-0034-00	CR	157-0034-02	PP
156-0034-01	CR		
156-0035-00	CR	156-0035-02	PP
156-0035-01	CR		
156-0039-00	CR	156-0039-02	PP
156-0039-01	CR		
156-0041-00	CR	156-0041-05	CR
156-0041-01	CR		
156-0043-00	CR	156-0043-03	CR
156-0043-01	CR		
156-0043-02	CR		
156-0047-00	CR	156-0047-02	CR
156-0047-01	CR		
156-0058-00	CR	156-0058-02	CR
156-0058-01	CR		
156-0072-00	CR	156-0072-00	PP
156-0072-01	CR		
156-0078-00	CR	156-0078-02	CR
156-0078-01	CR		
156-0079-00	CR	156-0079-02	CR
156-0079-01	CR		
156-0081-00	CR	156-0081-02	CR
156-0081-01	CR		
156-0093-00	CR	156-0093-02	CR
156-0093-01	CR		
156-0118-00	CR	156-0118-03	CR
156-0118-01	CR		
156-0128-00	CR	156-0128-01	CR
156-0129-00	CR	156-0129-02	PP
156-0129-01	CR		
156-0140-00	CR	156-0140-02	CR
156-0140-01	CR		
156-0141-00	CR	156-0141-02	CR
156-0141-01	CR		
156-0143-00	CR	156-0143-02	PP
156-0143-01	CR		
156-0145-00	CR	156-0145-02	CR
156-0145-01	CR		
156-0146-00	CR	156-0146-02	PP
156-0146-00	CR		
156-0153-00	CR	156-0153-02	CR
156-0153-01	CR		
156-0171-00	CR	156-0171-02	CR
156-0171-01	CR		
156-0172-00	CR	156-0172-02	CR
156-0172-01	CR		
156-0175-00	PP	156-0175-02	PP
156-0175-01	CR		
156-0180-00	CR	156-0180-04	CR
156-0180-01	CR		
156-0180-02	CR		
156-0186-00	CR	156-0186-02	PP
156-0186-01			

continued on page 8

From	Status	To	Status
156-0219-00	CR	156-0219-02	CR
156-0219-01	CR		
156-0221-00	CR	156-0221-02	PP
156-0221-01	CR		
156-0248-00	CR	156-0248-02	CR
156-0248-01	CR		
156-0301-00	CR	156-0301-02	MP
156-0301-01	CR		
156-0303-00	CR	156-0303-01	CR
156-0320-00	CR	156-0320-03	CR
156-0320-01	CR		
156-0321-00	CR	156-0321-02	CR
156-0321-01	CR		
156-0323-00	CR	156-0323-02	CR
156-0323-01	CR		
156-0325-00	CR	156-0325-02	CR
156-0325-01	CR		
156-0326-00	CR	156-0326-02	CR
156-0326-01	CR		
156-0331-00	CR	156-0331-03	CR
156-0331-01	CR		
156-0371-00	CR	156-0371-02	CR
156-0371-01			
156-0376-00	CR	156-0376-01	PP
156-0381-00	CR	156-0381-02	CR
156-0381-01	CR		
156-0382-00	CR	156-0382-02	CR
156-0382-01	CR		
156-0383-00	CR	156-0383-02	CR
156-0383-01	CR		
156-0384-00	CR	156-0384-02	CR
156-0384-01	CR		
156-0385-00	CR	156-0385-02	CR
156-0385-01	CR		
156-0386-00	CR	156-0386-02	CR
156-0386-01	CR		
156-0387-00	CR	156-0387-02	CR
156-0387-01	CR		
156-0388-00	CR	156-0388-03	CR
156-0388-01	CR		
156-0388-02	CR		
156-0391-00	CR	156-0391-02	CR
156-0391-01	CR		

From	Status	To	Status
156-0392-00	CR	156-0392-03	CR
156-0392-02	CR		
156-0403-00	CR	156-0403-02	CR
156-0403-01	CR		
156-0404-00	CR	156-0404-01	CR
156-0412-00	CR	156-0412-02	CR
156-0412-01	CR		
156-0413-00	CR	156-0413-02	CR
156-0413-01	CR		
156-0418-00	CR	156-0418-01	CR
156-0422-00	CR	156-0422-02	CR
156-0422-01	CR		
156-0424-00	CR	156-0424-02	CR
156-0424-01	CR		
156-0459-00	CR	156-0459-02	CR
156-0459-01	CR		
156-0462-00	CR	156-0462-02	PP
156-0462-01	CR		
156-0464-00	CM	156-0464-02	CR
156-0464-01	CR		
156-0469-00	CR	156-0469-02	CR
156-0469-01	CR		
156-0479-00	CR	156-0479-02	CR
156-0479-01	CR		
156-0480-00	CR	156-0480-02	CR
156-0480-01	CR		
156-0481-00	CR	156-0481-02	CR
156-0481-01	CR		
156-0529-00	CR	156-0529-02	CR
156-0529-01	CR		
156-0530-00	CR	156-0530-02	CR
156-0530-01	CR		
156-0646-00	CR	156-0646-02	CR
156-0646-01	CR		
156-0651-00	PP	156-0651-02	CR
156-0651-01	CR		
156-0652-00	CR	156-0652-02	CR
156-0652-01	CR		
156-0656-00	CR	156-0656-02	CR
156-0656-01	CR		
156-0679-00	CR	156-0679-01	CR

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From	Status	To	Status
156-0690-00	CR	156-0690-03	CR
156-0690-01	CR		
156-0694-00	CR	156-0694-02	CR
156-0694-01	CR		
156-0707-00	CR	156-0707-03	CR
156-0707-01	CR		
156-0718-00	CR	156-0718-03	CR
156-0718-01	CR		
156-0721-00	CR	156-0721-02	CR
156-0721-01	CR		
156-0724-00	CR	156-0724-02	CR
156-0724-01	CR		
156-0727-00	CR	156-0727-01	CR
156-0730-00	CR	156-0730-02	CR
156-0730-01	CR		
156-0733-00	CR	156-0733-02	CR
156-0733-01	CR		
156-0735-00	CR	156-0735-02	CR
156-0735-01	CR		
156-0739-00	CR	156-0739-02	CR
156-0739-01	CR		
156-0784-00	CR	156-0784-02	CR
156-0784-01	CR		
156-0789-00	CR	156-0789-02	CR
156-0789-01	CR		
156-0793-00	CR	156-0793-02	CR
156-0793-01	CR		
156-0798-00	NP	156-0798-02	CR
156-0798-01	CR		
156-0844-00	CR	156-0844-02	CR
156-0844-01	CR		
156-0850-00	CR	156-0850-02	CR
156-0850-01	CR		
156-0852-00	CR	156-0852-02	CR
156-0852-01	CR		
156-0865-00	CR	156-0865-02	CR
156-0865-01	CR		
156-0875-00	CR	156-0875-02	CR
156-0875-01	CR		
156-0910-00	CR	156-0910-02	CR
156-0910-01	CR		
156-0914-00	CR	156-0914-02	CR
156-0914-01	CR		

From	Status	To	Status
156-0916-00	CR	156-0916-02	CR
156-0916-01	CR		
156-0955-00	CR	156-0955-02	CR
156-0955-01	CR		
156-0956-00	CR	156-0956-02	CR
156-0956-01	CR		
156-0982-00	CR	156-0982-03	CR
156-0982-01	CR		
156-0994-00	CR	156-0994-02	CR
156-0994-01	CR		
156-1059-00	CR	156-1059-01	CR

Memory selection guides available on CYBER

A program in now available on the CYBER B machine for obtaining up-to-date memory selection guides. The memory selection guides available are: dynamic RAMs, eraseable programmable ROMs, flexible disks, mask ROMs, programmable ROMs and static RAMs. Another file is available which contains the Memory and I/O Component Engineering responsibilities.

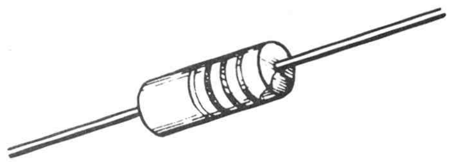
To access this program type:

GET,MENU/UN = ACCFCED<CR>
MENU<CR>

For more information, contact **Caroline Driver (ext. DR-2555) or Chuck Neal (ext. DR-2009).**

Carbon comp's need extra tolerance

Some board testing areas have been experiencing high reject rates of carbon composition resistors. The resistance has been higher than their rated ±5% tolerance would seem to allow.



Unfortunately, almost anything that happens to a carbon composition resistor, other than applying something under rated power to it, causes it's resistance to increase. Moisture, temperatures either side of 25°C and even voltages lower than the rated test voltage all cause an increase in resistance. We can't just change the specification and require the manufacturer to ship resistors that don't behave that way because these characteristics are inherent in carbon composition resistors. If an application requires the desirable characteristics of carbon composition resistors, it must also tolerate the undesirable ones just mentioned.

We've been using these resistors (commonly called "ABs" because Allen-Bradley is our largest supplier) since Tek was founded. Most circuits using 5% ABs can accommodate greater than 5% resistor tolerances, so the changes with temperature, moisture and voltage have caused very few problems. The resistors being rejected now would probably perform satisfactorily. They do meet the specification even though, after solder flow and board washing, they measure "out of tolerance" on the high side. When dried out by baking at 100°C for 96 hours the resistance is again within the ±5% tolerance. The application of operating power will also eventually restore the lower value.

Setting board test limits

In determining fault levels for a board test with ABs, you must allow +7% to +10% for 5% parts, and +15% for 10% parts. This may seem strange, but we must allow for changes occuring in transit, storage, soldering and washing.

If you have further questions regarding the use of carbon composition resistors, contact **Ray Powell (ext. DR-2550).**

Metal dust contamination from desk lamps?

The Luxo adjustable desk lamp (FL-1, P/N 003-0290-00) and the illuminated magnifier (LFM-1, P/N 003-0881-00) which are used throughout Tek are possible sources of metal dust contamination.

Recently, I was using my personal LFM-1 over some paintings. As I adjusted the attitude of the magnifier head, dark specks appeared on the work which smeared like graphite particles when touched. Closer examination of the entire work area and disassembly of the lamp located the source.

The movable joint between the magnifier head (or the lamp shade of the FL-1) and the adjustable arms is a metal-to-metal friction fit. With use, the joint wears, creating very fine aluminum and steel particles which will eventually fall from the lamp. In areas requiring critical cleanliness (such as microelectronics fabrication, photolithography, CRT assembly and detailed drafting), this metal dust may be causing problems.

Installing two nylon washers (P/N 210-1017-00) between the joint and the adjustable arms should help a great deal. However, the ultimate solution would be to replace the metal joint pieces with a suitable plastic part, which the vendor might be able to supply.

Juan Ochoa, ext. 6174
Hybrid Circuits Engineering

Correction from CN 287

The last issue of *Component News* incorrectly listed a coax voltage rating for Tek P/N 175-1043-00 (a 95-ohm coax cable). The values should have read 80°C and **300 volts.** If you have any questions, please contact Elizabeth Doolittle (ext. DR-2309).

Laminates for printed circuits

Laminates used for printed circuits are primarily thermosetting plastics produced by combining layers of resin-impregnated (or coated) base materials in a press under heat and pressure. The base materials may be cellulose paper, glass cloth or mat, asbestos fabric, cotton cloth or mat, nylon or silica cloth, etc. Resins used include phenolics, epoxies, melamines, silicones, polyesters, polyimides and others.

The properties of laminated products can be varied considerably by blending different types of resins, using different base materials or by changing the manufacturing process. This results in a variety of grades with predetermined characteristics to serve specific needs, see Table 1, next page.

Laminates for electrical/electronic applications usually require high insulation resistance, low dissipation (power) factor, low moisture absorption, high bonding strength, good heat resistance (up to 120°C in normal applications), low warpage and good dimensional stability.

Composite metal-plastic laminates

Metals can be bonded to most laminated plastics. Usually pretreated to remove oxides, a metal may be clad to one or both sides of a plastic laminate. Combining laminates with metals offers design advantages such as better weight-to-strength ratios, wider range of electrical characteristics, better bearing surfaces, wider temperature range capability, increased dimensional stability, more toughness, high abrasion resistance and formability.

Foils used for bonding to laminates include aluminum, gold, silver, lead, copper, beryllium copper, nickel, tin, stainless steel, Kovar and other magnetic alloys. Nickel and Kovar (an alloy of iron-nickel and cobalt) have good weldability and non-corrosion properties.

Printed circuit materials usually employ copper foil in claddings because of copper's outstanding electrical conductivity and etchability. Copper foil of very high purity is preferred, but electrodeposited copper (EDP) can also be substituted. (Note: soft-drawn, rolled and annealed copper offers better flex failure resistance and has approximately twice the tensile strength of EDP copper. It is, however, available in widths of 24 inches only, and when clad to epoxy laminates gives weaker bond strength.)

Pre-preg (B stage) materials

A number of fabrics or fibers, notably glass cloth, are available with semi-cured (B stage) resins. These are called pre-pregs and consist of a base material impregnated with a synthetic resin under carefully controlled partial cures. These materials are used for binding together individual circuit layers of multilayer circuit boards. For the electronics industry, epoxies are commonly used, although there are other synthetic resins for pre-pregs. Many forms of reinforcing fibers are available too, but the glass-fiber reinforcing materials are more frequently used.

Benefits derived from using pre-pregs include: less expense and time involved for short runs and prototype assemblies, ease in handling during the molding process, and improved formability. Disadvantages of using these materials are: room temperature cures are not possible, limited storage life depending on the resin system (usually 30-90 days only), needs refrigeration for stability prior to use and it is more expensive than the raw material.

For dielectric purposes, the thickness of the pre-preg should be twice that of the copper foil. These pre-pregs are available in both general purpose and flame retardant types.

If you have any questions about these laminates, please contact **Bella Geotina (ext. DR-2471).**

continued on page 12

Table 1 — Circuit board materials used at Tek

Resin	NEMA/MIL grade	Characteristics/applications
Epoxy (woven glass-fabric base)	G-10, FR-4, G-11 FR-5	Characterized by their superior wet-out abilities; are chemically inert; very good mechanical properties and outstanding electrical properties. G-10 and FR-4 are for room temperature applications, G-11 and FR-5 are heat-resistant up to 170°C.
Polytetrafluoroethylene (woven glass-fabric base)	GT, GX	These laminates are known for their outstanding heat and chemical resistance. GX is designed for microwave applications and has tighter tolerance than the GT with regard to dielectric constant and thickness of the core.
Polyimide (woven glass-fabric base)	GI	Offers outstanding heat resistance; has good resistance to delamination, blistering and puncturing; chemically inert, very flexible and has excellent dimensional stability.
Polystyrene	—	Material has high surface and volume resistivity; hard and rigid; however, it is sensitive to oily substances, has low temperature resistance and poor UV stability.
Polysulfone	—	Favorable characteristics: high creep modulus, tough and strong, resistant up to 150°C and UL recognized. It has high resistance to acids and alkali, but is attacked by Ketone, chlorinated hydrocarbons and aromatic hydrocarbons.
Polyphenylene oxide	—	Excellent punchability, low creep, solderable and good dimensional stability over a wide temperaure range. **IMPORTANT — This material is not recommended because of a lack of qualified sources.**

Danray comes to Tech. Comm.

Danray has arrived at Technical Communications. Our new Danray numbers are:

Carolyn Schloetel, mgr. 1762
Nancy Peate 1763
Cliff Morgan 1764
Rich Amber 1765
Eileen Yee 1766
Loretta Clark 1768
Mike Quigley 1770
Lola Janes 1771
Jacquie Calame 6867

New personnel in E/M Component Engineering

Katherine Dennett has joined the Electromechanical Component Engineering group. Katherine's primary duties will be to provide technical support for materials and chemicals. She can be reached at 78-552, ext. DR-2498.

John C. Thomas has also joined the E/M group, and will be responsible for electric motors, fans, transformers and other related components. John can be reached at 78-552, ext. DR-2466.

Bob Aguirre, manager
E/M Component Engineering

TECHNICAL STANDARDS

The function of Technical Standards is to identify, describe, and document standard processes, procedures, and practices within the Tektronix complex, and to ensure these standards are consistent with established national and international standards. Technical Standards also provides a central repository for standards and specifications required at Tektronix.

New/revised Tek standards

Tektronix Standard 062-2860-00, **Finish Standard — Anodized Finishes,** has been published. This is a replacement for Volume 1, Standard F-210. The purpose of this standard is to provide information relating to anodized finishes on aluminum and aluminum alloys.

Tektronix Standard 062-5408-00, **Inspection Standard, Knob Skirt.** Issued 24 Feb 81.

Tektronix Standard 062-4467-00, **Material and Inspection Standard,** Recommended Practice, Aluminia Ceramic. Issue Date 16 Feb 81.

Other new documents

MIL-E-15597E **Electrodes, Welding, Covered, Coated** Aluminum

SES Standards Engineering Society Inc. 29th Annual Conference Proceedings 1980.

ANSI/ASQC Z 1.15-1979 Generic Guidelines for **Quality** Systems

MIL-C-49230 **Counter Pulse,** Electronic, 18 Gigahertz (GHz) TD-1338

MIL-W-25038E **Wire,** Electrical, High Temperature and Fire Resistant, General Specs

MIL-STD-104B Limits for Electrical **Insulation Color** with Color Swatches

MIL-STD-1562B Lists of Standard **Microcircuits;** Notice 1

UL 544 Standard for Medical and Dental Equipment, Revision pages for Second Edition, March 10, 1981

UL 478, Standard for Electronic Data-Processing Units and Systems, Revision pages for Fourth Edition, February 27, 1981

MIL-C-22442A **Cable Assemblies,** Aircraft Audio, Gen'l Spec

MIL-I-45208A Inspection System Requirements

NBSIR 79-1956 NVLAP Glossary of Terms for **Library Accreditation,** Product Certification and Standardization

AS 2288 Australian Standard — Guide to the Selection and Use of **Fire Tests** for Plastics Materials and Products

ASTM D 1730 Preparation of **Aluminum** and Aluminum-alloy Surfaces for Painting

MIL-STD-1286C **Transformers,** Inductors and Coils

FIPS PUB 64 Guidelines for Documentation of Computer Programs and Automated Data Systems for the Initiation Phase; **Software Documentation**

FIPS PUB 67 Guideline for selection of Data Entry Equipment; **Hardware Data Entry Equipment**

Copies of these standards are available from Technical Standards (58-306), ext. DR-1800

32K EPROMs at Tek

This article describes the 4K X 8 EPROMs presently part numbered at Tek. Two new devices (Intel's D2732A-3 and Hitachi's HN462532) are covered here, too.

156-1403-00 The Intel D2732. Presently Intel is switching production from the D2732 to the D2732A. Four other vendors are currently being evaluated to fit the 156-1403-00, 450nS specification. Designers and manufacturing areas should be aware that a Mod will be necessary if use of the D2732A-3 (156-1598-00) is anticipated.

156-1598-00 The Intel D2732A-3. It is felt that the D2732A-3 is a step ahead of its competitors. By shrinking the die and by the use of HMOS-E technology, Intel has managed to bring the access time to 300nS. The remainder of the D2732A family (as yet, not part numbered at Tek) is even faster — the D2732A is 250nS and the D2732A-2 is 200nS.

The pinout of the 2732A family makes it upward compatible with the 2764 64K EPROM. In addition, by lowering the programming voltage to 21 volts, Intel has maintained programming compatibility with the 2764.

One result of the D2732A-3 evaluation is the fact that bringing Chip Enable ($\overline{CE}$) low after Output Enable ($\overline{OE}$) could cause glitches on the outputs. The glitches occur before data is valid, that is, before T_{CE}.

Intel acknowledges this problem and claims a future revision will clear it up. The Tek application driven spec stipulates that Output Enable fall simultaneously with, or after Chip Enable.

Presently, there are no second sources for the D2732A-3. However, we expect at least one manufacturer will produce such a component within the next year.

156-1596-00 The Hitachi HN462532. This component is a 450nS device and is not a pin-for-pin replacement for the 2732. Rather, it follows the so-called "TI pinout." It does not have the Output Enable function, merely a Chip Enable on pin 20 ($\overline{CE/PGM}$). Also, pin 21 is V_{PP} and pin 18 is A_{11}. We are currently looking at two other vendors as potential second sources.

For more information, please contact **Jim McKay, ext. DR-2557, or Pat Emmons, ext. DR-2009 (Memory and I/O Component Engineering).**

ComponentNews NewComponents

This column is designed to provide timely information regarding new components, vendors, availability and price. "New Components" can also be used as an informal update to the Common Design Parts Catalogs. Samples may or may not be available in Engineering Stock.

Vendor	Number	Description	When Available	Tek P/N	Engineer to contact, ext.
		digital devices			
Intel	8088	Microprocessor, 8-bit	now	N.A.	W. Hart, DR-2572
		memory and I/O devices			
Hitachi	2532	EPROM, 32K, 450nS T_{ACC}	now	156-1596-00	P. Emmons, DR-2009
Intel	2732A-3	EPROM, 32K, 350nS T_{ACC}	now	156-1598-00	P. Emmons, DR-2009
Motorola	MC68701	Microcomputer with 2K EPROM	now	156-1579-00	John Higley, DR-2316
AMD	27S181DC	PROM, 1K x 8, 60nS Access	now	156-1608-00	J. McKay, DR-2557
AMD	9517-5	Controller, 5MHz Programmable DMA	——	156-1606-00	Ken Smith, DR-2319
Intel	8237-2	(Direct Memory Access)			Ken Smith, DR-2319
AMD	AMZ8103	Tranceivers, 8-bit Tri-State Bidirectional Bus	——	156-1597-00	Ken Smith, DR-2319
National	8DP8303				Ken Smith, DR-2319
		optoelectronic and passive devices			
Mallory	TCG	Capacitor, 90µF, 250VDC axial lead aluminum electrolytic, 0.75 x 2.2"	now	290-0955-00	Don Anderson, DR-2545
Mallory	TCG	Capacitor, 20µF, 400VDC axial lead aluminum electrolytic, 0.62 x 2.2"	now	290-0958-00	Don Anderson, DR-2545
Sprague	673D	Capacitor, 27µF, 150VDC single ended, low ESR aluminum elect, 0.7ARMS ripple current, 0.75 x 1.2"	May	290-0962-00	Don Anderson, DR-2545
TRW	X363UW	Capacitor, 0.15µF ±2%, 400V metallized polypropylene	now	285-1227-00	Don Anderson, DR-2545
TRW	X363UW	Capacitor, 0.82µF ±5%, 400V metallized polypropylene	now	285-1228-00	Don Anderson, DR-2545
TRW	X363UW	Capacitor, 1.84µF ±5%, 400V metallized polypropylene	now	285-1229-00	Don Anderson, DR-2545
Electrocube	410D	Capacitor, 0.027µF ±2%, 100V polystyrene and foil	now	285-1233-00	Don Anderson, DR-2545
TRW	X463UW	Capacitor, 0.0039µF ±5%, 200V metallized polycarbonate	now	285-1234-00	Don Anderson, DR-2545
Plessey	160	Capacitor, 0.22µF ±10%, 400V metallized mylar "minibox"	now	285-1235-00	Don Anderson, DR-2545

component news

Component News is published by
Technical Communications
(58-122)

Jacquie Calame, editor
Eileen Yee, illustrator
Loretta Clark, layout/paste-up

To submit an article, contact Jacquie on ext. DR-6867.
For additions or changes to the distribution list,
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92-515

MICHAEL A MIHALIK

COMPONENT NEWS