TEK COMPANY CONFIDENTIAL

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component news

CA3130/40/60

Don't touch that offset adjust pot

An op amp performance quirk has surfaced which is serious enough to restrict the safe use of certain components or applications. Specifically, this article deals with unexpected performance variations resulting from offset voltage adjustment.

Armed with information about a component problem and its implications, designers should be better able to weigh the design possibilities and decide how a component's idiosyncrasies will affect a particular application, and a particular Tektronix product.

An op amp's CMRR, PSRR, A_{OL} and V_{OS} drift[1] are all known to be affected by the use of a V_{OS} potentiometer (due to the resulting perturbations in input stage current). But, a startling new effect has been observed on unity gain bandwidth and phase margin. This effect is so bad on one particular op amp (the CA3140, Tek P/N 156-0921-xx and 156-1134-xx) that, when V_{OS} is adjusted over its range, the gain bandwidth product (GBW) varies over a 5:1 range from 3MHz to 15MHz, and the internal **unity gain** compensation fails to stabilize the amp in gains below about 4.

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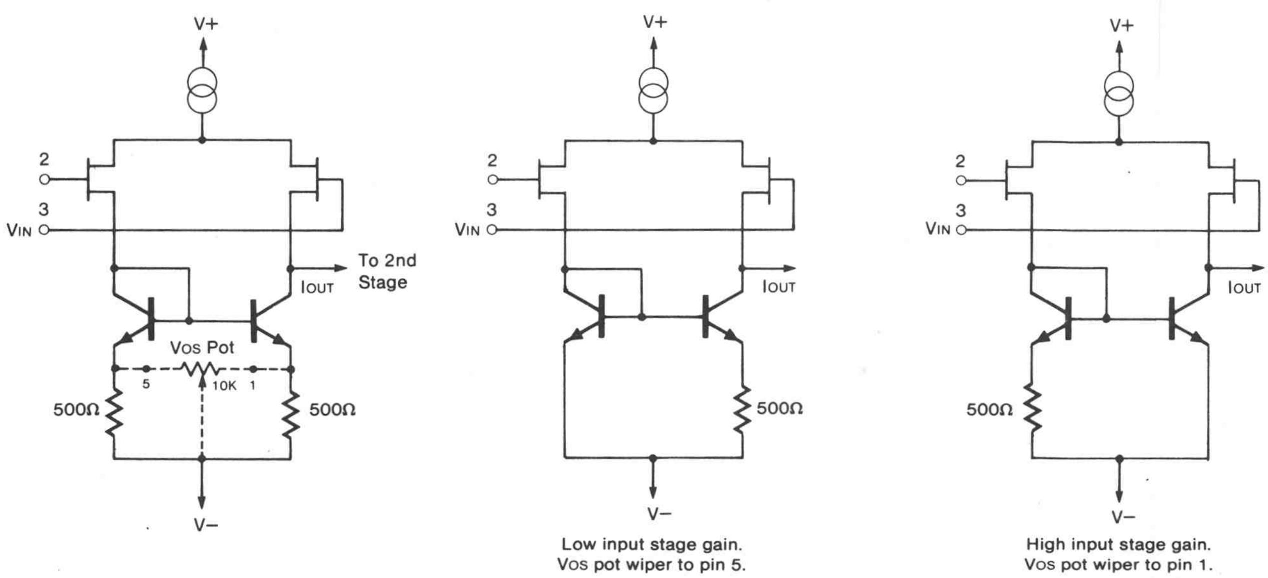


Figure 1 — CA3140 input stage gain variation

ALSO IN THIS ISSUE

Effects of this magnitude are also observable in the CA3130 and CA3160 op amps (Tek P/N 156-0686-xx and 156-1114-xx).

Why?

V_{OS} adjustment is usually achieved by unbalancing the collector currents in the input differential pair. This forced difference in collector currents creates an offset voltage which cancels whatever initial offset was present.

However, the most common method for creating this imbalance also changes the transconductance (g_m) of the input stage because it unbalances the emitter resistors in the current mirror (see Figure 1 on page 1). This change in input stage gain is seen directly in the GBW product. A sufficient increase in this gain can "uncover" the second pole in the response, boosting it above the critical gain of unity and creating frequency stability problems (see Figure 2).

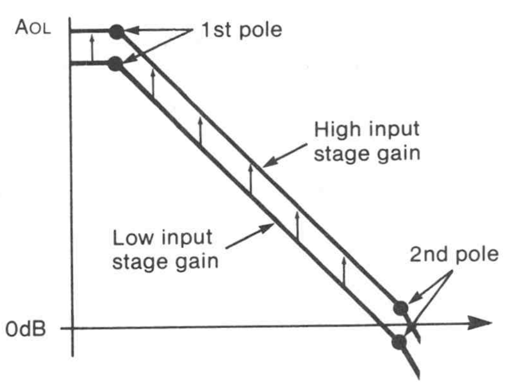


Figure 2 — Increased input stage gain boosts entire open loop gain curve and raises second pole above unity gain.

The CA3140 has a twofold complication in this respect. First, the MOS input transistors have a large initial offset and drift which require a large range to guarantee complete nulling. Second, RCA has been overly generous by providing an enormous **400mV** offset adjustment range. This results in large changes in input stage gain and the gross bandwidth and stability variations observed.

While a good circuit design should have a low sensitivity to variations in op amp GBW, the loss of unity gain stability is unexpected and very serious.

Limit the adjustment range for stability

This variation can be greatly reduced, and frequency stability assured, by adding resistance in series with the adjustment pot to stabilize the input stage gain (see Figure 3).[2] Although reduced, the adjustment range will be adequate if R_S is kept below 4KΩ.

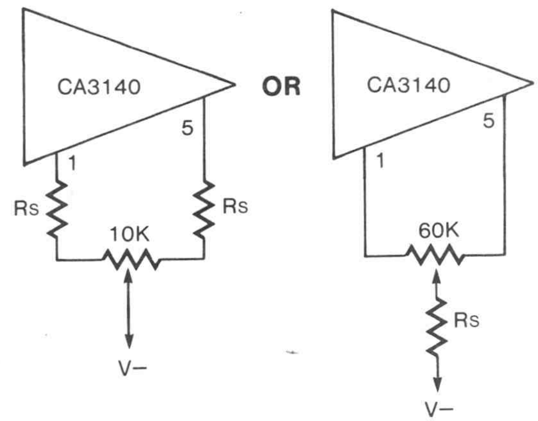


Figure 3 — Recommended alternate nulling circuits reduce bandwidth and stability variations (Rs ≤ 4KΩ)

Other op amps not affected

A study was done to determine if an effect of this magnitude is present in other Tek op amps. The results indicate that the CA3130, CA3140 and CA3160 are the only problem parts.

While a change in GBW (due to V_{OS} adjust) was observable in virtually every type of op amp, it did not exceed about 20% and stability was not significantly affected (because of internal controls on the input stage gain).

For more information

If you have questions about op amp performance, please contact me at 78-557, ext. BDR-2308.

Willie Rempfer
Analog Comp. Eng.

[1] There are exceptions (e.g. OP-05 and OP-07).

[2] RCA refused our request to provide gain stabilizing resistors (R_S) on the chip.

NEC765 read problem

MDP technicians have experienced problems reading data on their NEC765-based floppy disk controller (FDC) using diskettes formatted or written with a Tektronix CP115 (RT-11 based) disk drive/controller. The problem manifests itself by indicating missing Data Address Marks.

The standard diskette format (IBM3740 format: single-density, 128-byte sectors) is as follows:

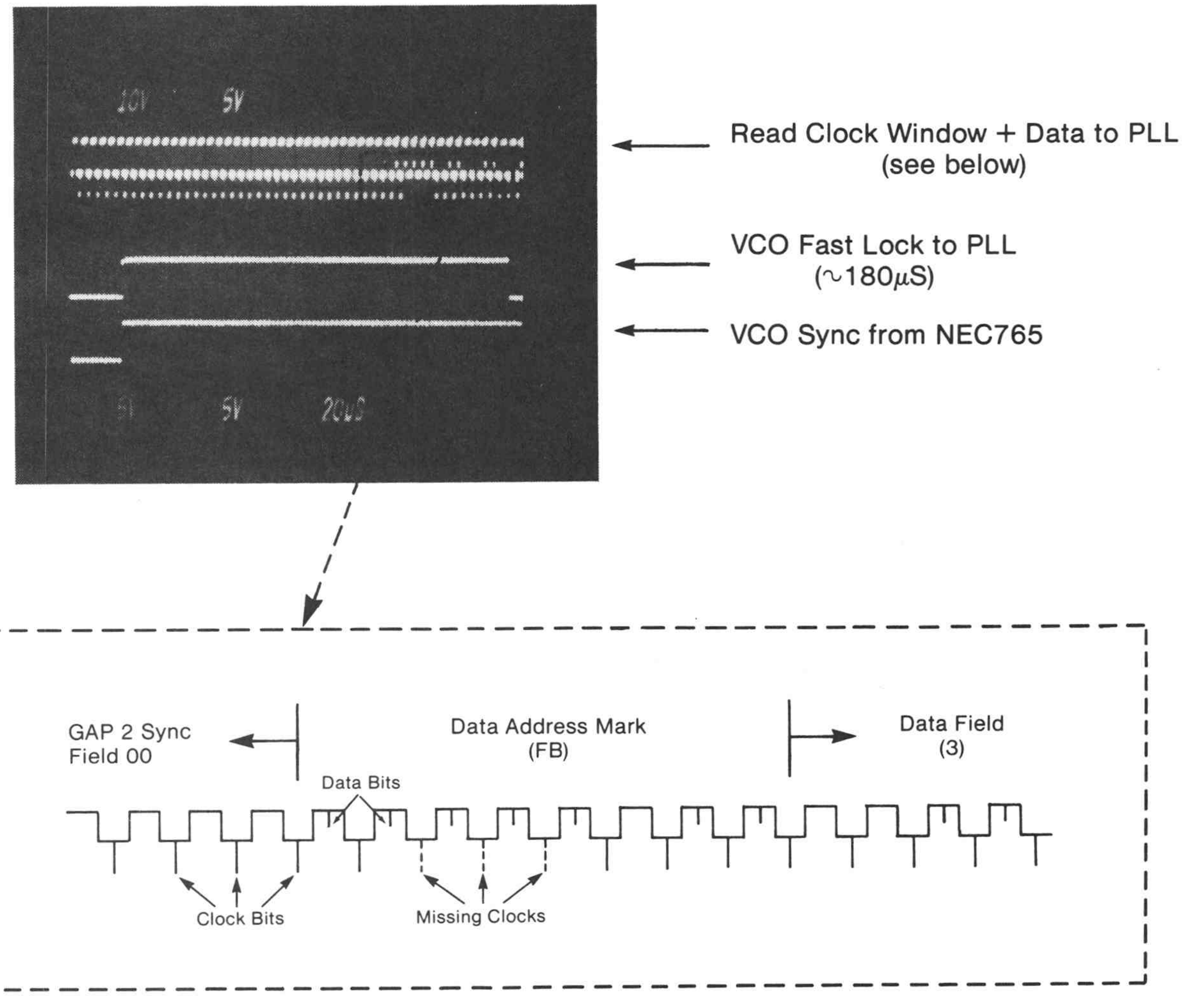
	Number of bytes	Hex value of data written	
	40	FF	(GAP 5)
	6	00	Sync Field
	1	FC	Index Mark
	26	FF	(GAP 1)
Repeats for 26 sectors (last GAP is ∿ 247 bytes of FFs)	6	00	Sync Field
	1	FE	ID Address Mark
	1	XX	Track Number
	1	XX	Head Number
	1	XX	Sector Number
	1	00	Size (0 for 128 byte/sector)
	2	XX	CRC for ID Field
	11	FF	(GAP 2)
	6	00	Sync Field
	1	FB	Data Address Mark
	128	XX	Data Field
	2	XX	CRC for Data Field
	27	FF	(GAP 3)
	6	00	Sync Field

Reading a diskette (formatted by the CP115 system) with a Western Digital 1793 controller revealed that GAP 2 was written with 10 bytes of FF and 6 bytes of 00 Sync — not the standard 11 bytes of FF and 6 bytes of 00 Sync. Also, GAP 3 was found to have 28 bytes of FF and 6 bytes of 00 Sync rather than the standard 27 bytes of FF and 6 bytes of 00 Sync.

The waveform photos in Figures 1 through 3 (see following pages) were taken while looping on Track 3 of the RT-11 formatted diskette, and looping on a READ sector command using the NEC765/Intel 8272 FDC (Tek P/N 156-1412-00). Figure 1 explains how to interpret the data in the CRT photos. Figures 2 and 3 compare the good (standard) and bad (non-standard) formats for the GAP 2 Sync Field. In each photo, the binary diskette data is depicted by the upper waveform; this is referenced to the Fast Lock Sync for PLL (phase-locked loop) and to the VCO (voltage controlled oscillator) sync from the NEC765.

Figure 2 depicts timing relationships showing how the NEC765 enables the VCO Sync relative to the Sync Field. The entire Sync Field of GAP 2 is shown (48 bit cells, 6 bytes). The VCO is not enabled until 2 bytes of zeros have passed. This leaves 4 bytes to detect the Data Address Mark. If formatted correctly with 11 bytes of FFs, the VCO is enabled with only 1 byte of zeros having passed. This leaves 5 bytes to detect the Data Address Mark. Figure 3 shows the waveform for a correctly formatted GAP 2 Field.

continued on page 4



NOTE — VCO was enabled only 4 bytes, ~32 bits cells before Data Address Mark.

Figure 1 — Illustration of diskette showing GAP 2 Sync and Data Address Mark

The failure of the NEC765 in reading the bad format is the result of two problems:

1. The PLL may not have had time to lock onto the data in time to detect the Data Address Mark.

2. The NEC765 does not look for the Data Address Mark until the VCO is enabled for at least four bytes. This explains why the correctly formatted diskette with five bytes of Sync can be read. The incorrectly formatted GAP 2 does not allow the NEC765/Intel 8272 FDC sufficient time to detect the Address Mark.

NOTE — The WD179X floppy disk controller, made by Western Digital, begins looking for the Address Mark after detecting two bytes of zeros in the Sync Field (or four bytes of "00" or "FF" on systems using modified frequency modulation). The WD179X can read the bad format with no problems.

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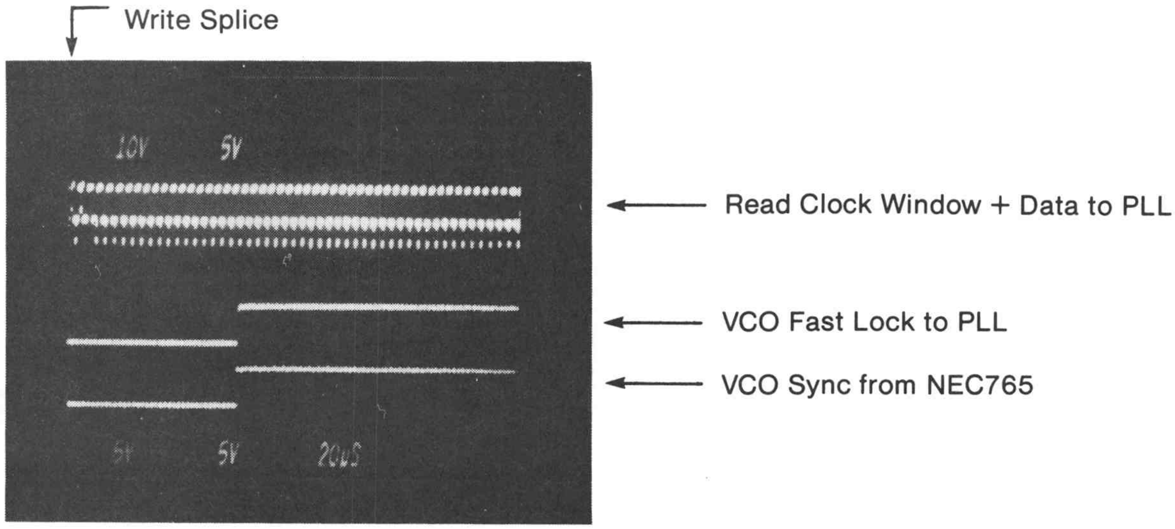


Figure 2 — GAP 2 Sync Field (bad format)

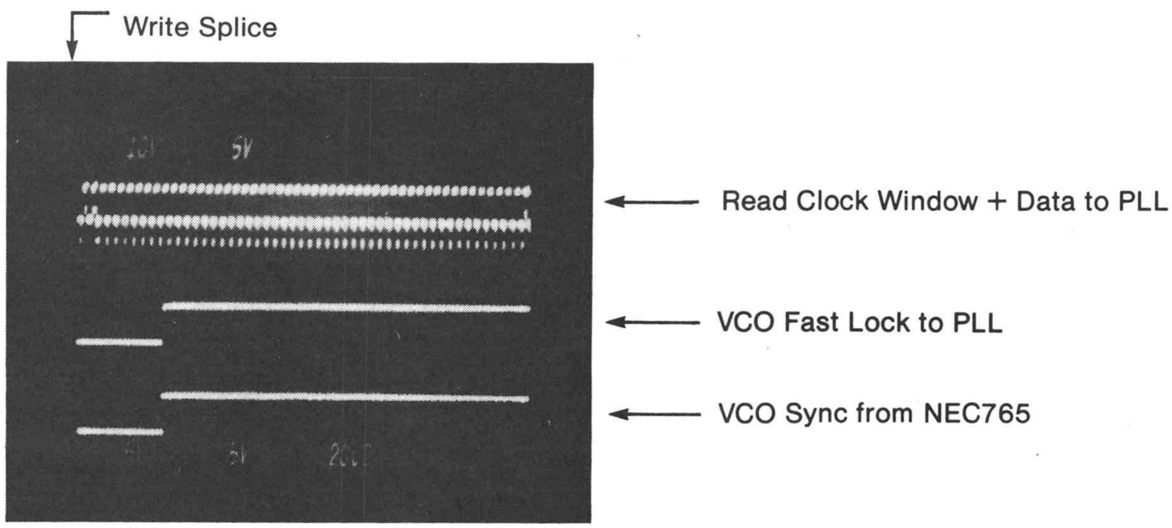


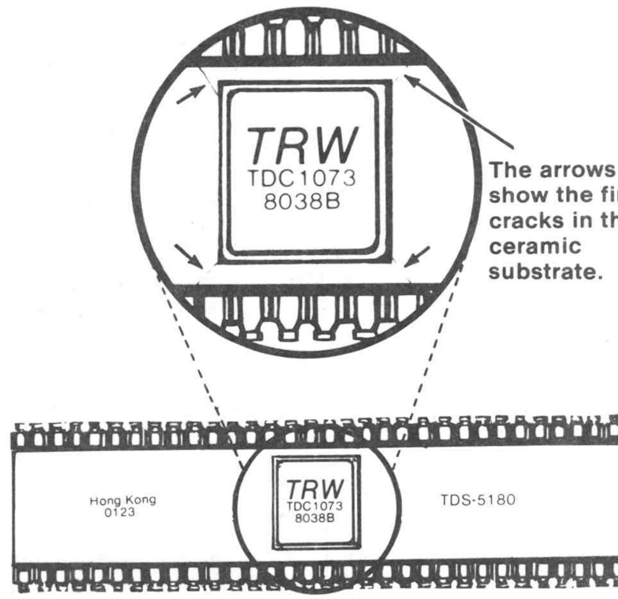
Figure 3 — GAP 2 Sync Field (good format)

For additional information, please contact **Brad Benson, Memory and I/O Component Engineering, ext. BDR-2557**.

Reliability suffers when parts are inserted/removed from sockets

A recent analysis of plant failures from the 468 product line revealed some interesting information on a mechanical stress-related failure mechanism. The devices analyzed were high-speed A/D converters (TRW P/N TDS-5180, Tek P/N 156-1345-00). The failure mode reported for the parts was excessive non-linearity.

These parts are housed in 64-pin ceramic dual in-line packages. Analysis revealed that the failure mechanism was micro-cracks in the package which caused non-uniform stresses on the chip within the package (see illustration below). The cracks in the packages are undetectable without special equipment, such as a low-power microscope with side lighting, dye-penetrant detection or a method using Fluorinert FC77® in a vapor generator.



The arrows show the fine cracks in the ceramic substrate.

The cracks appear to be caused by an uneven stress (end-to-end) on the package while it is being inserted into or removed from a socket. The uneven pressure will cause the package to flex beyond its structural limitations. This excessive flexing develops cracks which radiate from the cavity corner outwards.

This problem can be minimized (or eliminated) by using special care when inserting or removing large ceramic packages, and by following these instructions:

Inserting — Apply even pressure across the whole package (**not** one end first) during insertion. Pushing with the palm of your hand, or using a block of wood or plastic will provide the uniformity required to insert the package into the socket.

Removing — To remove these packages, avoid putting any leverage tool under one end and prying up. Instead, use a long letter opener (Tek P/N 002-1247-00) which can be slipped between the part and socket. **Do not** use a screwdriver to accomplish this. Slide the letter opener to one side of the package pins, then rotate or twist the opener. This will cause one side of the package to be lifted, and the other side can then be lifted in the same way.

Using these insertion/removal techniques will minimize micro-cracks in these large format packages. The result should be reduced plant and field failures for this failure mechanism.

If you have any questions, please contact **Dan Harris, Component Reliability Engineering (58-061), ext. BDR-1611**.

OP-27/37 op amps respecified

Precision Monolithics Inc. (PMI) has respecified the OP-27/37 op amps to avoid the distortion problem revealed in *Component News* #285.

The latest PMI data sheets show the open loop gain to be specified with a load resistance of 1KΩ instead of the previous 600Ω.

This spec change removes the crossover distortion problem from the specified operation region, leaving these op amps as good performers, unmatched for precision, low noise operation.

For more information, contact **Willie Rempfer, Analog Component Engineering, 78-557, ext. BDR-2308.**

TO-220 mounting system features high voltage withstand capability

A new integrated TO-220 transistor mounting system has been developed by TV Products Mechanical Engineering, in cooperation with Analog Component Engineering. The system features very high breakdown voltage capability, with attention given to variations in device mounting torque.

The mounting system consists of two parts: a purchased Chomerics "Cho-therm R 1674" silicon rubber insulator, and a Tek-made polysulfone shoulder washer. A special heat-sink counterbore detail is also required. Figure 1 shows an exploded view of this system.

Electrical characteristics

This new system was developed to accommodate the Hi-Pot requirement for UL instrument certification. Common methods used for TO-220 package mounting were not adequate for the 1500 volt specification. What was desired was a long-stemmed shoulder washer and a relatively tight-fitting insulator — both not commercially available. Thus, the need to develop our own system became apparent.

The results of breakdown voltage testing (both initial and repeated "strikes") are shown in Table 1.

Trial #	Largest hole (.151 in.)	Smallest hole (.131 in.)
1 (initial breakdown)	1500V	1850V
2	1400V	1600V
3 (repeated break-	1400V	1900V
4 downs with	1400V	1550V
5 same insulator)	1400V	1550V
6	1400V	1600V

Table 1 — Hi-Pot test results

The manufacturer's electrical ratings are:

Volume resistivity (per ASTM D257)
 2 X $10^{14}\Omega$/cm(typ)

Dielectric constant (per ASTM D150)
 4 @ 1MHz(typ)

Breakdown voltage (per ASTM D149)
 1500V (min)

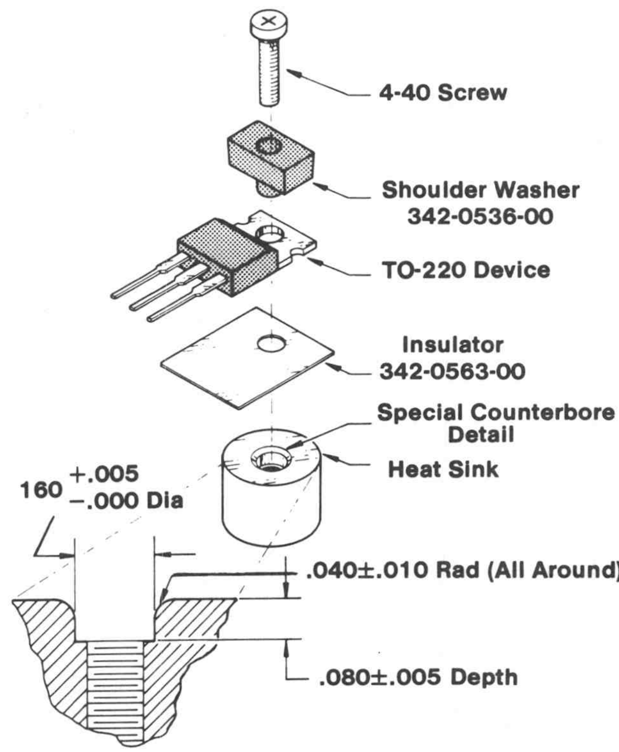


Figure 1 — Typical installation for new TO-220 transistor mounting system. Heat sink shown is round for illustrative purposes only.

Mechanical considerations

The polysulfone (yellow or black) shoulder washer (Tek P/N 342-0536-00) acts like a spring washer with TO-220 device case styles. It is expressly designed for a #4-40 UNC 2B-type screw, with a nominal applied torque range of 4 to 5 in-lbs. As mounting screw torque is increased, the washer expands contact with the top of the device tab and begins to apply pressure toward the heat sink with the special counterbore detail that must be used (see Figure 1).

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On the underside of the shoulder washer a circular recess prevents stress-cracking of the washer, and prevents the device tab from being forced into the region around the counterbore. If the tab were forced into the detail it would distort, thereby reducing contact area, increasing device operating temperature and causing possible die fracture.

Thermal attributes

The maximum recommended transistor case operating temperature is 125°C, although 150°C can be used for brief periods. At this temperature some elastic characteristics of the polysulfone spring shoulder washer will be lost, but not to the extent that it will cause device failure.

The average $R\theta_{CS}$ of this system is 1.47°C/W. The thermal resistance between tab and heat sink will decrease somewhat between 10 and 100 hours of operation. This occurs because the insulator material will "cold-flow" into void areas and increase the effective contact area.

One final caution — do not use any heat sink "grease" with this insulator material. Compounds currently used (e.g., Dow #4 and Thermalcote) contain solvents that will attack the silicon rubber insulator material.

For more information

If you have any questions about this mounting system, please contact **Jim Williamson (ext. BDR-2552)** or **Ed Joste, TV Products Mechanical Engineering (ext. BDR-1330).**

Safe handling of beryllium

Bella Geotina, Materials and Electromechanical Component Engineering, has prepared a paper outlining safe handling procedures for beryllium. The paper describes the material, its uses at Tektronix, possible health hazards and preventive measures.

If you're interested in receiving a copy, please contact Bella on ext. BDR-2315.

Lithium battery handling precautions

For Tek purposes, lithium batteries should be separated into two classifications: solid-state or "reserve" type cells, and non-reserve cells. Most applications at Tek are for solid-state cells which should be used for memory support only and not for primary power.

Solid-state batteries use a non-aqueous electrolyte and include heart pacemaker cells (lithium iodine), watch cells (lithium/manganese dioxide, lithium/copper oxide), and some lesser known cells not now available for consumer use. They are low-current batteries designed to deliver about 10 mA or less, and are sealed with no provision for venting because no gas is generated even under forced discharge. All solid-state cells have the same discharge characteristics — an internal increase in resistance throughout life with an abrupt rise in resistance at end of life.

Because of their small size and discharge characteristics, no special application restrictions are necessary. The only operating precaution is that when the battery is floated across an a.c.-operated supply, the amount of charge current must be limited to a few nanoamps to prevent cell bursting. These batteries are thermal, i.e., their temperature rises as they supply power, and any abnormal situation like charging compounds the problem. No fuse will protect against this.

Discharged lithium batteries of all types are dangerous. There is always some free lithium remaining in the cell plus some possibility of impurities. These may result in fire or dangerous residues from side reactions. Even with zero terminal voltage the danger is there. Since solid-state batteries are small, the amounts of dangerous materials in them are tiny and injury to humans, however possible, is not very probable.

Non-reserve type cells are dangerous and should have guidelines for their use. The Navy issues such guidelines. If non-reserve batteries are used in instruments, include a hazardous material label on the instrument, and its manual must cover the care, feeding and disposal of this type of battery.

Byron Witt
Electromechanical Component Engineering
ext. BDR-2479, 78-552

The TORX drive system — what's in it for Tek?

Several mechanical design engineers have questioned whether Tektronix should put more emphasis on standardizing the fasteners (nuts and bolts) used in our products. The specific system under consideration is the TORX Fastener Drive System, a method said to have significant advantages over other fastening systems (e.g., slotted screwhead, Phillips/cruciform system, hex/12-point drive system).

Component Engineering, Manufacturing Engineering and Purchasing are currently taking a look at converting to the TORX system. This conversion would affect all fasteners used in new designs. In addition, we would reduce the variety of sizes and lengths currently used.

The overall question to be answered by the three groups involved — is it worth the time and expense required to make such an extensive change? Also, what should be done about existing products and tooling? What about the special drive tool required to service Tek instruments in the field? In the end, would we be glad we changed over to TORX, or would we wish we had left well enough alone?

So far, the results of our inquiry confirm that this is an important question that requires our attention. The potential is there for significant cost savings. Following are comments from some of the parties concerned. Your comments and suggestions are welcome.

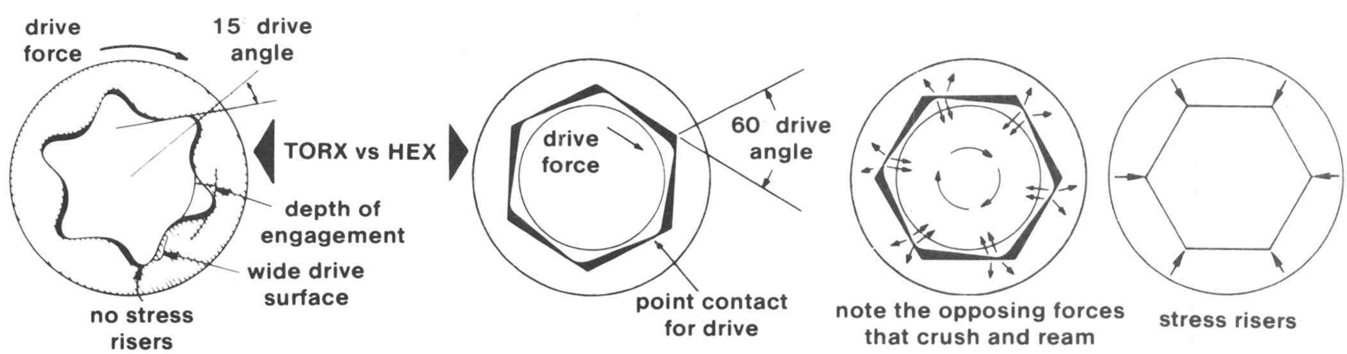

Figure 1 — The TORX drive system uses curves to reduce peak stresses on the drive bearing surfaces of fastener heads. These fasteners are easier to turn and have less tendency for head burring.

Jim Deer — Component Engineering

"What is the fastener problem, and how does the TORX system handle it? The problem is that using a slot-headed screw, it is difficult to insert the screw into a threaded hole, and difficult to withdraw it. The screwdriver slips, and you damage the screwhead, and then the trouble really begins. It is very difficult to use power-driven tools on a slot-headed screw.

To alleviate this, the Phillips and other cruciform drive systems were developed. This gives centering of the drive tool, but a lot of end load force has to be applied to avoid the "camout" tendency due to the sloping drive surface. The hexhead and the 12-point drive system give centering and avoid camout, but they are still not optimum because they generate side forces which can exceed the strength of the material.

The TORX drive system can be thought of as a modification of the hex drive system, in such a way as to achieve maximum torque handling capability. As the illustration shows, the lines and angles of the hex drive are curved surfaces. This results in a broad drive bearing surface. There are no sharp corners where stress can concentrate. Whereas the drive angle for a hex configuration is 60°, giving a large radial force component, the TORX system has a 15° drive angle. This minimizes the radial forces which can cause the walls to crack.

The reduced camout forces in turn reduce the amount of end load that the operator must apply when installing the screw. It is said that one of the most significant features of this new system is the resulting reduction in operator fatigue.

If we decide to standardize on the TORX system, it will have to be a high level management decision, and it will be necessary to assemble the appropriate facts and figures upon which such a decision could be based. We are investigating this, and will prepare a report with conclusions and recommendations."

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Austin Carpenter — Component Quality Control

"In 1966, we at Tek were sold on a drive system for our screws. This system was POZIDRIV and we were assured that it would be the industry standard and readily available. The POZIDRIV system did not prove to be an industry standard, it has to be ordered special at extra cost per item and in most cases in lot quantities of 50,000 or more. We have over 50% of our screws with usages less than 40,000 per year. Cadmium-plated hardware has a guaranteed shelf life of six months, so if we buy enough hardware to meet the minimum for POZIDRIV, we would have to scrap out most of the shipment as it becomes tarnished.

With all of this information in mind we have been accepting the Phillips recess on many of our production screws. Some screws are all POZIDRIV, some are all Phillips and some are mixed.

We have had many complaints from production areas and from customers due to burred screws and most of this comes from driving Phillips screws with a POZIDRIV driver. I have asked several of the areas to use only Phillips drivers to help solve this problem, but many production areas still believe that they need the POZIDRIV driver to drive screws with a POZIDRIV recess. Both Phillips and POZIDRIV screws can be driven to the proper tightening torque with Phillips driver bits.

In order to solve most of our problems with screws, I would recommend changing to TORX drive on all screws except set screws, plastic and adjusting screws. At the same time we should make an attempt to use standard lengths (such as 1/8" increments) and get away from cadmium plating where possible (such as using stainless steel), except on thread cutting or forming applications.

By designing to standard lengths on new products and modifying where possible on existing products we can increase the usage on each remaining item. This will make the 50,000 minimum order quantity more acceptable to our planning and storage areas."

Dave Elle — Production Component Purchasing

"When choosing TORX or any other drive system as a standard screw drive system for use at Tektronix, several factors must be considered. First, what will be the advantages and disadvantages of adopting a new drive system? Second, what testing, if any, should be done to determine the need for a new drive system? Third, is the drive system available for all screw types, in all quantities, in all materials, and in all diameters and lengths? Fourth, is tooling for all drive sizes universally available? Other factors will, of course, need to be evaluated but these four are primary to any consideration of a new drive system.

Tooling for TORX drive is almost universally available now. Tools are available from Sears, Wards, most automotive supply stores and national chain hardware stores, and are beginning to appear at typical neighborhood hardware stores. With six domestic tool manufacturers currently licensed, the outlook for even better supplies is good to excellent.

TORX drive is currently available from 27 domestic and 21 foreign licensed manufacturers. It is available in all screw types, materials and diameters. While TORX is available for all length screws, it is not generally recommended for screws longer than those suggested as maximum length per diameter by the licensor, Camcar, and the American Screw Association (see Table 1).

Modified ASA length recommendation

Screw size	2	4	6	8	10
	.125	-	-	-	-
	.188*	.188*	-	-	-
	.250	.250	.250	.250	.250
	.312*	.312*	.312*	.312*	.312*
	.375	.375	.375	.375	.375
	.500	.500	.500	.500	.500
	.625	.625	.625	.625	.625
	.750	.750	.750	.750	.750
	-	.875	.875	.875	.875
	-	(†)1.000	1.000	1.000	1.000
	-	-	-	1.250	1.250
	-	-	-	-	1.375*
	-	-	-	-	1.500

(†)Usually available, but recommend No. 6 X 1.000 panhead, flathead and hexwasher head only (for Tektronix, use 100 degree flat head).

Table 1

In as much as TORX drive is now used in instruments using Modular Packaging System (MPS), the 2200 series and the 2400 series, testing TORX drive may seem moot. However, except for MPS, TORX drive was adopted for the other instruments without any testing for the need for a new drive system. A definitive test of TORX vs other drive systems still needs to be done so that Tektronix can determine exactly what would be gained (if anything) by the use of TORX, and if approved where and how it should be used.

The advantages and disadvantages of the use of TORX drive at Tektronix have been discussed for about five years. The main use until about one year ago was in high-torque

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applications (e.g., screws could not be seated in some applications using drive systems other than TORX). Other stated advantages of TORX are reduced end loading thereby reducing operator fatigue, and elimination of camout during screw insertion and removal.

The most obvious disadvantages of TORX drive currently are availability and cost. As stated earlier there are 27 domestic manufacturers licensed to produce TORX drive fasteners, however, except for the licensor all charge 4-6% more for TORX drive than POZIDRIV. Also, TORX drive fasteners are available only from fastener manufacturers in minimum quantities of 50,000 to 100,000. Cost of purchasing the tools for all using areas at Tektronix must also be considered.

In general, the superiority of TORX drive over all others is thought by most to outweigh any disadvantages of its use.

If Tektronix is to adopt TORX drive as a standard drive system, we have the opportunity to exact some excellent cost savings by simultaneously establishing fastener standards in length increments, materials, etc. On page 10 is a table of length increments recommended by the American Screw Association (ASA) for the five most commonly used sizes at Tektronix. The only exceptions are indicated by asterisks and are included because of their heavy use at Tektronix.

My recommendations for use of TORX drive at Tektronix are as follows:

1) No further general use be allowed until a thorough evaluation of TORX drive has been completed. This includes procurement costs and availability, potential savings/expense of installation, cost of installation, etc. ...

2) Stringent corporate standards for fasteners be established in conjunction with 1) above (e.g., use only panhead, 100 degree flathead and hexwasher head screws in 1/8" increments up to standard recommended lengths). Non-standard increments should be allowed only where usage would be 500,000 or more per year.

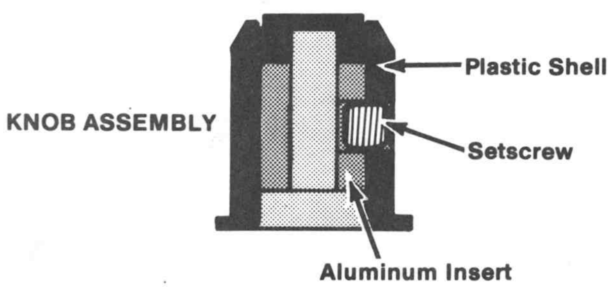
3) In combination with 1) and 2) above, implementation should be on a division-by-division basis with full conversion of all fasteners used in all instruments."

If you have any comments concerning this study to standardize fasteners, please contact **Kelly Cushing (78-552), ext. BDR 2461.**

The case of the wandering set screws

Plastics is receiving many complaints from assembly areas about knob set screws either being screwed into the knob too far, or not screwed in at all.

When screwed in too far, assemblers must take time to back out the set screw before putting the knob on its shaft.



When the screw has fallen out of the knob completely, extra time must be spent locating and reinstalling the screw. Often the loose set screw cannot be found, and the knob (cost about 50 cents) is discarded.

The problem concerns Series 1 and 2 knob families (366-0494-00, 366-1031-02) which have a 0.094 inch-long set screw in a 0.125 inch-deep wall. This leaves only 0.031" of tolerance (0.015" each end) which is not enough to compensate for screw migration caused by normal transit and handling.

Most other knobs have a greater wall thickness and do not present a problem.

Is there anyone out there who can suggest a practical way to keep the set screw in its knob at a proper depth? One problem to avoid in a solution is thread tightness or contamination. This prevents the set screw from contacting the shaft with enough pressure to prevent looseness and slipping.

Please contact **Betty Bohall, 08-538, Vanc. ext. 7214** with your suggestions.

Parts catalog erratum

The table below corrects errors published on page 13-15 of the January 1981, *Electromechanical Common Design Parts Catalog*. These are denoted as "Universal Circuit Board Mount" connectors. Corrections are printed in **bold face type**.

If you have any questions, please contact Joe Reshey, ext. BDR-2313.

Number of Positions	Dimensions A	B	C	Other	Part Number	§§ ST	CC
2	.550	.680	1.245	Right Angle	131-2590-00	PP	G+
3	**1.500**	.680	**2.500**	Right Angle	131-2589-00	PP	G+
4	.914	.375	NA	Straight	131-2391-00	PP	G
4	1.050	.680	**1.745**	Right Angle	131-2588-00	PP	H−
5	1.300	**.725**	NA	Straight	131-2586-00	PP	H
5	1.300	.550	NA	Straight	131-2621-00	PP	H+
6	1.550	.680	**2.245**	Right Angle	131-2587-00	PP	I
6	1.550	.680	**2.245**	Right Angle	131-2587-01	PP	I+

Parts catalog procedure change

In keeping with the current need to cut costs and improve efficiency, we are asking all *Common Design Parts Catalog* users to salvage their old catalogs (D/S 02-001) when they receive a new issue.

Each catalog is serialized (all new catalogs will have a serial number on the address label) and assigned to a specific person. Therefore, it is important that each of you take the responsibility to place your old catalogs in salvage.

We have recently received a number of requests for replacement catalogs, so it would be well worth your while to jot down your catalog serial number. This will enable you to identify your unique issue if it is misplaced.

The above change will save both time and money by greatly reducing the heavy mail traffic and hours opening mail. Additional savings will be realized if misplaced catalogs are retrieved.

We appreciate your cooperation in this matter and if you have any questions please contact the Parts Cataloging manager, Dorothy Peterson, on ext. BDR-2585.

New telephone extensions have also just been assigned to the Parts Cataloging group. They are:

Dorothy Peterson, manager	BDR-2585
John Kennedy, illustrator	2577
Nancy King, writer	2582
Norma Peterson, writer	2577
Sandra Phillips, tech. doc. aide	2582
Dawn Stover, tech. doc. aide	2591

Memory and I/O personnel change

Brad Benson, Memory and I/O Component Engineering, is now responsible for evaluating DRAMs, replacing Bob Goetz. Brad's other responsibilities include dynamic RAM controllers, magnetic bubble devices and flexible disk controllers. He can be reached at 78-557, ext. BDR-2557.

Mike Boer, manager
Component Engineering

Edgecard connector housing warpage

Component News 284 (Oct. 1980) reported that AMP's "low profile" edgecard connector line was prone to gross temperature-induced housing warpage (the housing material is Valox 420 SEO, a polyester thermoplastic). The disposition at that time was to disapprove this product for new design (see Table 1).

Since October, AMP has remedied the gross warpage by process changes. More subtle levels of warpage still exist, but they are acceptable and are being monitored in Incoming Inspection.

Solutions implemented

AMP's prescription for curing the gross warpage (which exhibited up to 0.090" of temperature-induced deformation) consisted of a series of molding process changes — injection speed was increased, virgin plastic melt temperature was decreased, and the previously cold molds were preheated prior to injection.

After the changes were instituted less severe levels of warpage (about 0.010-0.020") remained. However, post-molding heat treatment was ineffective in reducing the magnitude of this deformation. Apparently this is a manifestation of common material creep and indicates that the design capabilities of Valox have been exceeded.

AMP has introduced design changes to reduce this level of distortion. In addition, alternatives to Valox are being considered to ensure a stable product while maintaining the low-profile dimensions.

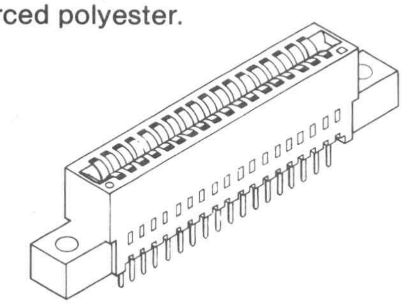
Overview of polymer chemistry

The basic building block of a polymer is an organic chemical compound called a monomer. As the name reveals, a polymer is a large number of monomers bonded into a somewhat linear molecule and oriented with other polymer chains into a matrix demonstrating some degree of short-range regularity. The average molecular weight, then, is related to the average number of monomers per chain and gauges, in a manner of speaking, the "extent" of the chain.

Tek Part Number	AMP Part Number
131-2056-00	2-530662-5
131-2282-00	2-530662-5
131-2059-00	3-530683-0
131-2059-01	3-530671-0
131-2282-01	2-530671-5
131-2279-00	3-530662-0

Table 1 — Low profile edgecard connectors now acceptable for new design

In polyester, these chains are bonded together by "tie molecules" which generally occur at the ends of the chain. The integrity of the ties and the extent of the chain in part determine the strength of a non-reinforced polyester.



Effect of AMP's solutions

As the material is heated from its solid state, various vibronic modes are excited. Should the melt temperature be excessive, thermal vibrations can deteriorate the effectiveness of the tie molecules after cooling. The result is a weakened product; the solution is to reduce the melt temperature.

An inordinately slow injection speed can allow premature crystallization resulting in both deteriorated ties and internal stresses built into the final part. If the product is subsequently heated beyond the glass transition temperature, an external stress will permit the weakened material to yield as it relieves the internal stresses. The same sort of effect can occur (e.g., premature crystallization and weakened ties) if the plastic is injected into a cold mold. The solution is to increase injection rate into a preheated mold. AMP has extended these efforts, and has subsequently alleviated the gross warpage problem.

continued on page 14

Quality control procedures

In addition to the process changes, AMP is now monitoring melt viscosity, regrind percentage and moisture content. The final product is then inspected for temperature-induced warpage. The allowed warpage is less than 0.010". At Tek, Incoming Inspection is subjecting mated connectors to elevated temperatures and inspecting to the same AQL as the manufacturer.

Conclusion

In my estimation, AMP has adequately demonstrated that the warpage problem has been remedied and that effective measures have been instituted to ensure stable housings in the future. Part numbers previously not recommended are now acceptable for new design.

For more information about these connectors, please contact **Joe Reshey (78-552), ext. BDR-2313.**

Guidelines for crystal oscillators

Recently, people have experienced difficulty getting reliable operation from crystals used with clock generator chips, TTL circuits and ECL oscillator circuits. Often the crystal gets blamed because after it's changed the circuit works.

Another reason why crystals become suspect is because the parts book identifies them as "parallel" resonant while the spec. sheet on the IC device specifies "series" resonant. Actually there is no difference between series and parallel (anti-resonant) crystals. These descriptions merely specify the kinds of circuits the crystals were operated in during manufacturing calibration.

Particularly affected are Intel 8284 and 8284A crystals (both are part numbered). The difference between the two is the 8284 has a terminal dedicated to a tank circuit which is used only for overtone crystals.

In series with the crystal is a 5 to 50 pF capacitor called a de-biasing capacitor. This cap removes d.c. from one side of the crystal and forces it to oscillate at a slightly higher frequency called the "parallel" or "anti-resonant" frequency. A 15 pF capacitor in series with the crystal raises the frequency about 480 ppm (.048%) above the series resonant frequency. In the literature these frequencies are called f_a for parallel and f_r for series.

With any oscillator (bipolar, IC chip, IC gate) you must know all the circuit components in order to evaluate it and select the proper crystal. If external components other than the crystal are introduced into the circuit (a 15 pF cap for instance), they must be accounted for in the feedback analysis.

At turn-on, the crystal will search for a frequency where the phase distribution around the feedback loop is 0° or 360°. At that frequency, the loop gain must be greater than one (preferably +10 dB) for oscillation to take place, and for good starting. The crystal resistance must be considered in the gain calculation. In this case, the higher the R_s (from the data sheet), the harder it will be to drive the crystal, thus requiring more loop gain.

Crystals manufactured specifically for use with microprocessors are produced using labor-saving and time-saving (often automatic) techniques not normally used. For instance, instead of grinding the required contour of the crystal one at a time in an optical lense cup, large numbers of crystals are tumbled in a rock polisher tube. This is called piped design.

Adjustment to frequency is done by introducing a halogen into the crystal case to bring the crystal down to frequency, rather than by evaporative back plating. Neither the piped design nor the halogen method produce low-resistant, uniform quality crystals.

If we try to pair a high-resistance crystal with a chip wanting a low-resistance crystal (both within their tolerances), our chances of achieving long-term reliability are poor. Crystals made by these methods are cheaper, and you get what you pay for no matter who makes them.

Byron Witt
Electromechanical Component Engineering
ext. BDR-2479, 78-552

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.

Chuck Sullivan, manager (41-260)

translation available

Technical Standards now has an English translation of **DIN 57883/VDE 0883, Opto-Electronic Couplers.** The standard, which became valid in 1980, includes information regarding electronic relays. Translation was done by Technical Help to Exporters (THE).

new standards available

ANSI A39.16 **Preparation of Scientific Papers** for Written or Oral Presentation
MIL-C-39003D **Capacitors, Fixed,** Electrolytic (Solid Electrolyte), Tantalum, Established Reliability
MIL-C-3965/25 (Style CL56) and MIL-C-39006/15 (Style CLR53) are cancelled.
MIL-G-18293B **Gauges, Pressure, Recording** is cancelled.
MIL-M-38510D Supplement 1H, General Specifications, **Microcircuits**
MIL-STD-1345B **Test Requirements Document,** Preparation of
MIL-T-7990B **Transmitter Temperature Electrical Resistance,** −70° to +300°C
NBS/GCR 80-287 A report on **Performance vs. Design Standards**
NBSIR 81-2297 A Technical Briefing on the **Initial Graphics Exchange Specification (IGES)**
NBS-SP-597 Symposium on **Optical Fiber Measurements,** 1980
NPFA **The National Electrical Code Handbook** — with complete text of 1981 Code
UL 20 Revision pages, Standard for **General-Use Snap Switches**
UL 62 Revision pages, Standard for **Flexible Cord and Fixture Wire**
UL 478 Fourth Edition revision pages, Standard for **Electronic Data-Processing Units and Systems**
UL 1010 Revision pages, Standard for **Receptacle-Plug Combinations** for use in Hazardous Locations
UL 1012 Revision pages, Standard for **Power Supplies**

Tektronix standards

062-5512-00 **Product Identification** Standard, issued 15 July 1981
062-4551-00 **Peltola Connector System,** issued 12 August 1981
062-5990-00 **Status of Technical Drawings,** issued 17 August 1981

Technical Standards can be reached through MAILMAN on the CYBER **A** machine (user number AACØCDS). For more information or for copies of standards, contact Bonnie Kooken, ext. BDR-1800, 58-306.

ComponentNewsNewComponents

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.
		analog devices			
TI	TL431C	Regulator, adjustable, precision, shunt regulator or Zener	now	156-1631-00	G. Sargeant, BDR-2540
		digital devices			
TI, NSC, SIG	74S113	Dual J-K, neg. edge, flip-flop, screened	now	156-1629-00	John Higley, BDR-2316
		memory and I/O devices			
MMI	63S141J	PROM, 256 × 4, STTL, T_{AA} = 45nS	now	156-1628-00	Pat Emmons, BDR-2009
Intel	D2764-4	EPROM, 8192 × 8, EPROM T_{AA} = 450 nS	now	156-1630-00	Pat Emmons, BDR-2009
		optoelectronic and passive devices			
Mallory	TCG	Capacitor, 290μF, 200V axial-lead alum. elect., 1" × 2.2"	now	290-0971-00	D. Anderson, BDR-2545
Sprague	450P	Capacitor, 0.22μF, 100V, metallized mylar stacked film, radial lead box	now	285-1241-00	D. Anderson, BDR-2545
Plessey	171	Capacitor, 0.033 μF, 250V, metallized polypropylene, radial lead, box type	now	285-1242-00	D. Anderson, BDR-2545
H-P	QLMP-0449	LED, rectangular, yellow, high rel.	now	150-1105-00	Al LaValle, BDR-2317
H-P	HLMP-0527	LED, rectangular, green, high rel.	now	150-1109-00	Al LaValle, BDR-2317
3M	---	Cable assembly, 40-conductor, 19.750 length, socket/socket, with strain relief	now	175-2266-01	E. Doolittle, BDR-2309
3M	---	Cable assembly, 24-conductor, 2.375 length, socket/D subminiature	now	175-4578-00	E. Doolittle, BDR-2309
3M	---	Cable assembly, 40-conductor, 1.80 length, 3 socket connectors	now	175-4067-00	E. Doolittle, BDR-2309
3M	---	Cable assembly, 50-conductor, 20.0 length, card edge/card edge	now	175-4551-00	E. Doolittle, BDR-2309
Berg	---	Cable assembly, 22 signal and 44 ground wires, 19.6 length, 1 socket	now	175-4549-00	E. Doolittle, BDR-2309
Spectra Strip	---	Cable assembly, 64-conductor (32 twisted pairs), 22.0 length, socket/socket	now	175-4745-00	E. Doolittle, BDR-2309
Spectra Strip	---	Cable assembly, 20-conductor (10 twisted pairs), 40.5 length, socket/socket	now	175-4550-00	E. Doolittle, BDR-2309

component news

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*** on maternity leave. Call Carolyn Schloetel (on BDR-6867) to submit an article.**
For additions or changes to the distribution list, contact Jill Miller at 19-123, ext. DR-4503.

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