component news

Feb. 15, 1979 COMPANY CONFIDENTIAL Issue 268

Trimmer selection guide

The trimmer list in the *Common Design Parts Catalog* is being revised to make component selection easier. So that designers can benefit before the next catalog is issued, we are printing the revised list here.

Of the 327 trimmer part numbers in the current catalog listing, only 188 are "preferred" or recommended for new design. It is expected that almost all new applications will be filled from this list. Another 88 part numbers are acceptable but not recommended for new design. These parts are different from those on the "preferred" list in some mechanical or electrical aspect, making them non-standard, more expensive, less available and/or less reliable. These "acceptable" parts are to be used only when the "preferred" part won't do, and only with an understanding of their limitations.

All the parts on the "preferred" list and most of the parts on the "acceptable" list have cermet elements. A few carbon or conductive plastic element types are on the "acceptable" list, where low cost and reasonable performance warrant their inclusion.

single-turn trimmers

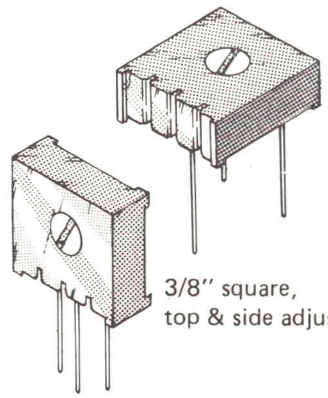
We make the following general recommendations for single-turn applications:

- The 3/8" square sealed trimmer is recommended for general purpose use in both top and side adjust styles. The modest cost of 30 to 35 cents and good reliability makes it the best value.

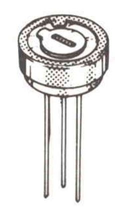
- Use the ¼" round sealed trimmer where board space won't permit using a larger, lower priced unit. Cost is about 55 cents each. The side adjust versions are more expensive (75¢) because of the plastic saddle, and we do not recommend the parts for that reason.

  If possible, use the 3/8" square side adjust parts, because they are only slightly larger than the ¼" round with plastic saddle.

- NOTE: Don't use ¼" round trimmers with TO-5 pin-outs (P/Ns 311-1258-00 through 311-1275-00). The pins are at the very edge of the substrate, making them difficult to manufacture. These parts are not on either selection list. continued on page 2



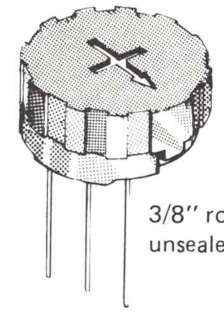
3/8" square, top & side adjust



1/4" round

Also in this issue

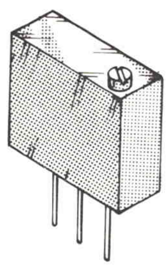
■ Where a sealed trimmer isn't needed or where cost is a concern, use the 3/8" round unsealed trimmer. Cost is now 22 to 25 cents each. Because the side adjust version bends over too easily when adjusting with a screwdriver, use the 3/8" square side-adjust version instead.



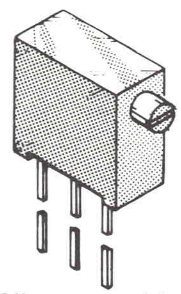
3/8" round, unsealed

multi-turn trimmers

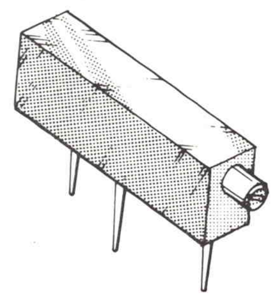
Where circuit conditions require greater adjustability than a single-turn unit can provide, two styles of multi-turn trimmers are available. One is 3/8" square, in which the single-turn element is actuated by a 20-turn worm and pinion gear. In the 3/4" long version, the wiper is moved along the straight element by a 20-turn leadscrew. The 3/8" square multi-turn costs about 85 cents, and the 3/4" long version is about 60 cents.



3/8" square multi-turn, top adjust



3/8" square multi-turn, side adjust



3/4" multi-turn

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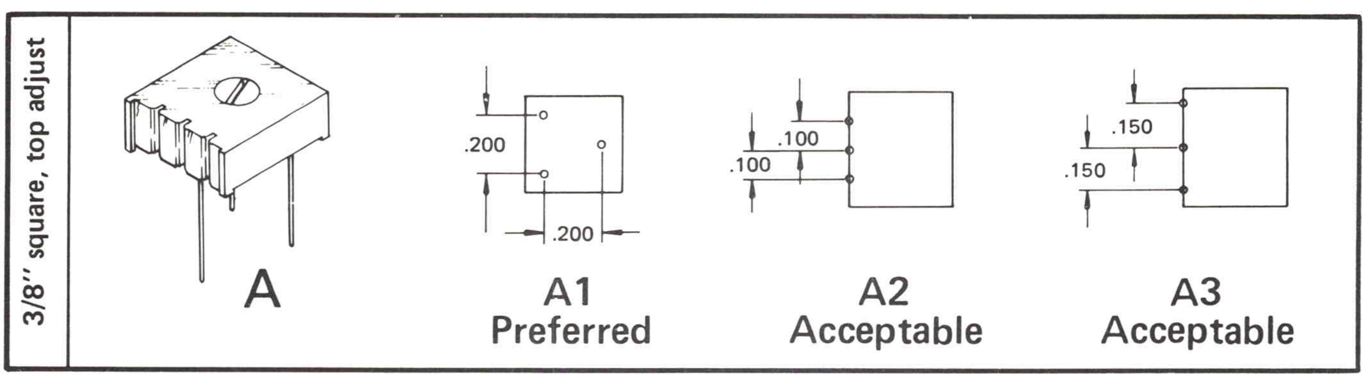
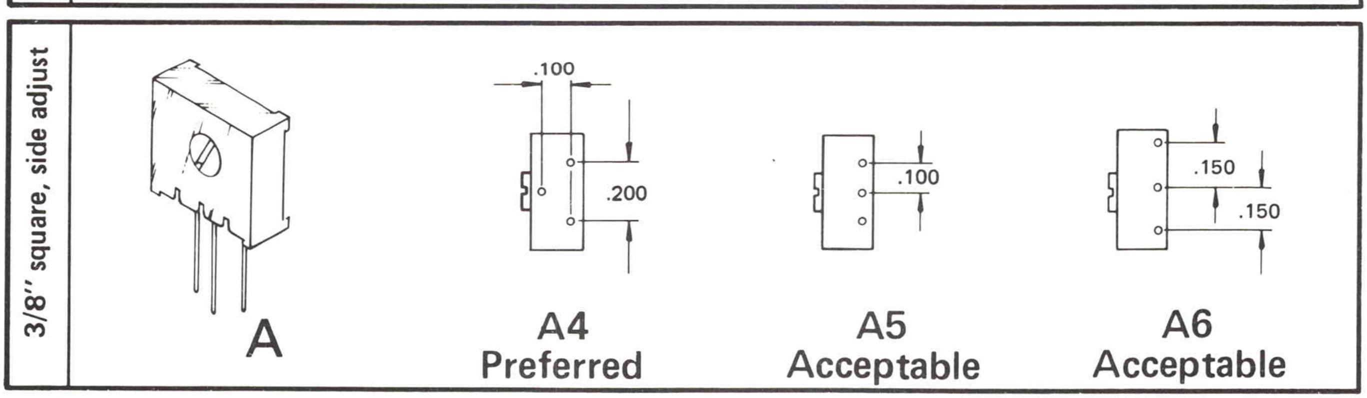
trimmer P/N list

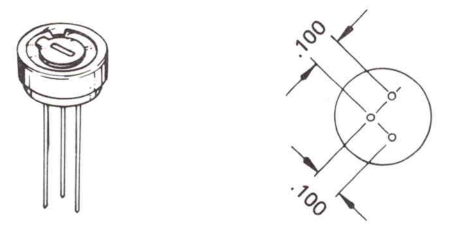
In the list below, each part number is followed by a letter and number identifying its shape and pin-out configuration. The identifiers correspond to those in the accompanying drawings.





continued on page 3

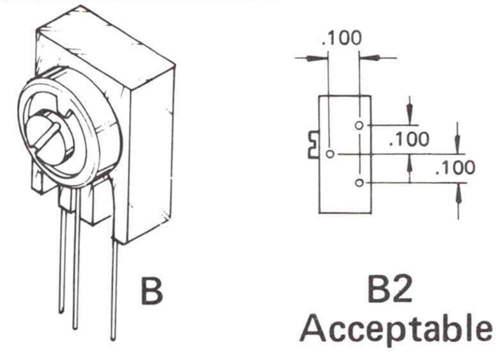
1/4" round, top adjust



B

B1
Preferred

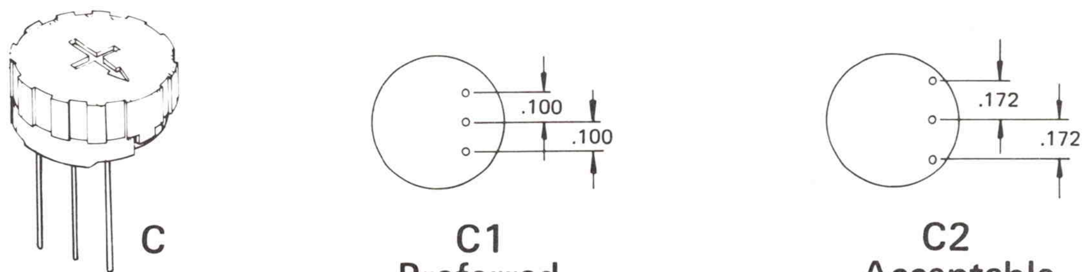
1/4" round, side adjust



B

B2
Acceptable

3/8" round, unsealed, top adjust



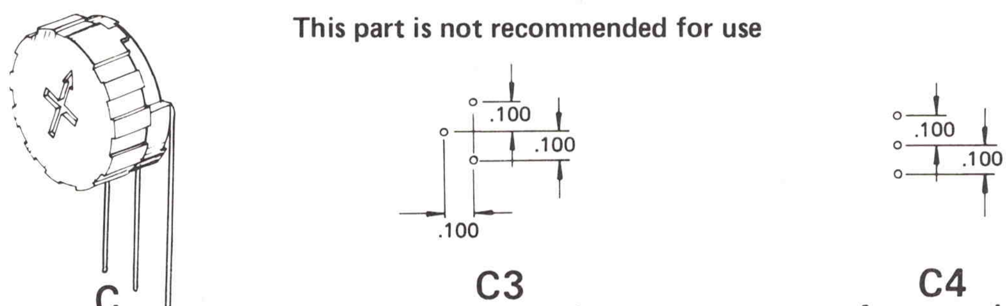
C

C1
Preferred

C2
Acceptable

3/8" round, unsealed, side adjust

This part is not recommended for use

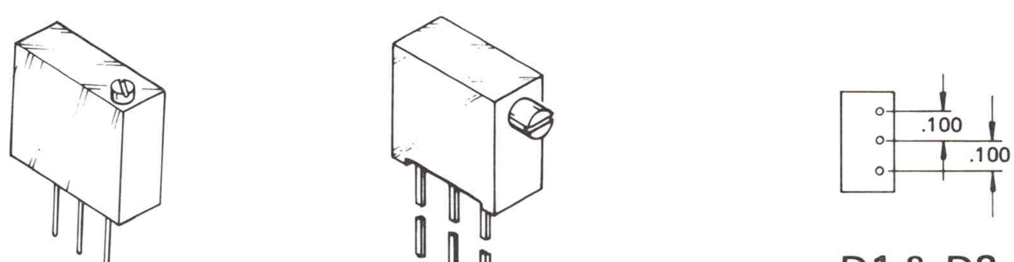


C

C3
Acceptable

C4
Acceptable

3/8" square, multi-turn top & side adjust

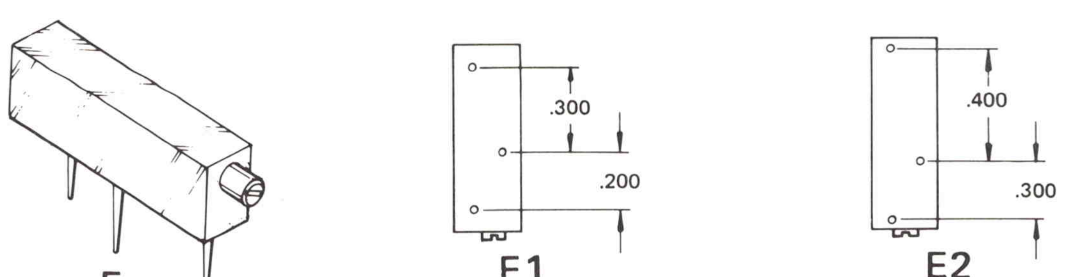


D1

D2

D1 & D2
Preferred

3/4" multi-turn



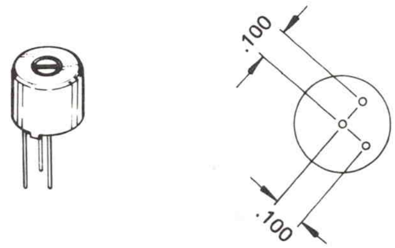
E

E1
Preferred

E2
Acceptable

continued on page 4

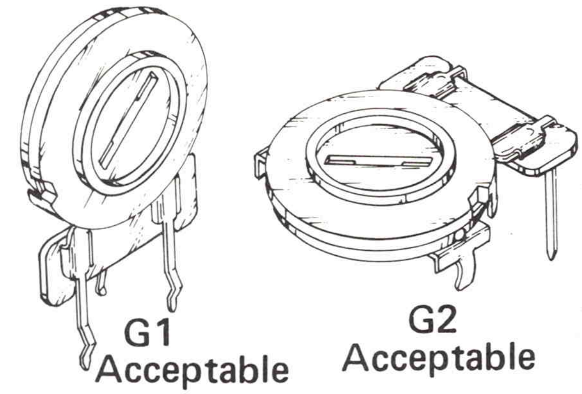
3/10'' multi-turn



F

F1
Preferred

5/8'' carbon



If you have any questions concerning this list or the selection guidelines previously discussed, please contact me at **58-299, ext. 5302.**

Gene Single

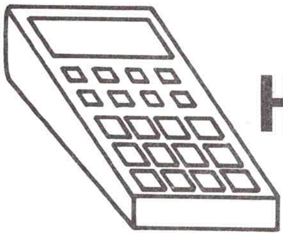
	Preferred		Acceptable	
10Ω	311-1594-00	C1	311-1294-00	B2
20Ω	311-1007-00	B1		
	311-1423-00	A1		
	311-1501-00	A4		
	311-1731-00	C1		
50Ω	311-0643-00	B1	311-1276-00	B2
	311-1149-00	E1		
	311-1221-00	A1		
	311-1568-00	C1		
100Ω	311-0622-00	B1	311-1120-00	G2
	311-1175-00	D1	311-1132-00	C2
	311-1222-00	A1	311-1140-00	A6
	311-1244-00	A4	311-1277-00	B2
	311-1488-00	E1	311-1328-00	G1
	311-1567-00	C1	311-2029-00	A3
	311-1858-00	D2		
200Ω	311-0605-00	B1		
	311-1036-00	D1		
	311-1167-00	E2		
	311-1566-00	C1		
	311-1859-00	D2		
250Ω	311-0978-00	B1	311-1124-00	G2
	311-1223-00	A1	311-1278-00	B2
	311-1236-00	A4	311-1308-00	G1
	311-1565-00	C1	311-1921-00	A5
	311-1680-00	E1		

continued on page 5

	Preferred		Acceptable	
500Ω	311-0634-00	B1	311-1139-00	A6
	311-1224-00	A1	311-1177-00	E2
	311-1248-00	A4	311-1279-00	B2
	311-1307-00	D1	311-1571-00	C4
	311-1489-00	E1	311-1920-00	A5
	311-1564-00	C1	311-1168-00	E2
1KΩ	311-0635-00	B1	311-1123-00	G2
	311-1225-00	A1	311-1138-00	A6
	311-1237-00	A4	311-1154-00	C2
	311-1340-00	E1	311-1280-00	B2
	311-1563-00	C1	311-1408-00	G1
	311-1860-00	D2	311-1572-00	C4
	311-1944-00	D1	311-1919-00	A5
1.5KΩ	311-1749-00	C1		
2KΩ	311-0609-00	B1	311-1370-00	G2
	311-1466-00	A1	311-1814-00	C3
	311-1562-00	C1	311-1918-00	A5
	311-1754-00	E1		
	311-1895-00	D1		
2.5KΩ	311-1226-00	A1	311-1141-00	A3
	311-1239-00	A4	311-1281-00	B2
	311-1417-00	A1	311-2003-00	G2
	311-1561-00	C1		
	311-1757-00	B1		
5KΩ	311-0633-00	B1	311-1137-00	A3
	311-1227-00	A1	311-1153-00	C2
	311-1238-00	A4	311-1204-00	G2
	311-1560-00	C1	311-1282-00	B2
	311-1862-00	B1	311-1314-00	G1
	311-1896-00	D1	311-1894-00	Spl.
	311-2039-00	F	311-1917-00	A5
	311-1339-00	E1		
10KΩ	311-0607-00	B1	311-1133-00	G1
	311-1228-00	A1	311-1199-00	G2
	311-1245-00	A4	311-1283-00	B2
	311-1319-00	E1	311-1750-00	E1
	311-1559-00	C1	311-1916-00	
	311-1861-00	D2		
	311-1943-00	D1		
15KΩ	311-1229-00	A1		
	311-1748-00	C1		
20KΩ	311-0644-00	B1	311-1284-00	B2
	311-1198-00	A4	311-1915-00	A5
	311-1230-00	A1		
	311-1338-00	E1		
	311-1558-00	C1		
	311-1879-00	D1		

continued on page 6

	Preferred		Acceptable	
25KΩ	311-1231-00	A1	311-1285-00	B2
	311-1240-00	A4	311-1315-00	G1
	311-1337-00	E1		
	311-1557-00	C1		
	311-1897-00	D1		
50KΩ	311-1035-00	B1	311-1134-00	A6
	311-1232-00	A1	311-1164-00	A3
	311-1233-00	A1	311-1286-00	B2
	311-1234-00	A1	311-1363-00	G2
	311-1246-00	A4	311-1914-00	A5
	311-1556-00	C1		
	311-1935-00	D2		
100KΩ	311-0613-00	B1	311-1136-00	G1
	311-1235-00	A1	311-1148-00	A3
	311-1241-00	A4	311-1152-00	C2
	311-1336-00	E1	311-1287-00	B2
	311-1555-00	C1	311-1302-00	G2
200KΩ	311-0660-00	B1	311-1288-00	B2
	311-1214-00	A1	311-1813-00	G2
	311-1242-00	A4	311-1303-00	C2
	311-1251-00	A1		
	311-1554-00	C1		
	311-1857-00	D2		
	311-1940-00	A4		
	311-1945-00	D1		
250KΩ	311-1553-00	C1	311-1166-00	C2
			311-1206-00	G1
			311-1733-00	C3
500KΩ	311-0606-00	B1	311-1289-00	B2
	311-1243-00	A4	311-1296-00	G1
	311-1252-00	A1		
	311-1253-00	A1		
	311-1552-00	C1		
1MΩ	311-0698-00	B1	311-1135-00	G1
	311-1247-00	A4	311-1290-00	B2
	311-1254-00	A1		
	311-1551-00	C1		
2MΩ	311-1255-00	A1	311-1205-00	G1
	311-1396-00	E1	311-1333-00	B2
	311-1550-00	C1		
	311-1646-00	A4		
2.5MΩ	311-1256-00	A1	311-1597-00	G1
5MΩ	311-1257-00	A1	311-1305-00	C2
	311-1399-00	A4	311-2000-00	G1
10MΩ	311-1304-00	C1		
15MΩ	311-2014-00	Spl.		
25MΩ	311-2015-00	Spl.		



How to maintain NiCd calculator batteries

NiCd calculator batteries perform best when used as portable devices without the AC line adapter. To ensure long life and full capacity, read the instructions included with your calculator and follow the recommendations.

Calculator batteries should be cycled — discharge fully (terminal voltage not less than 1V), then re-charge completely. Observe the low voltage indicator in the instructions for your particular calculator. Repeated discharging and recharging to the same partial level may develop a memory in the cell, making the battery deliver at less than capacity. If the cell is run to a partial discharge state only a few times, one complete discharge will remove this memory.

When a battery pack fails to accept a charge (generally indicated by a short operating life), the individual cells should be discharged through a 5Ω resistor on **each** cell. Discharge the cells to less than ½V. Then, charge the battery according to the instructions. This should restore the charge balance in the pack.

If this procedure fails to restore the battery to near capacity, one or more cells may need to be replaced. When replacing cells the capacity should be equalized as explained previously.

Basically, there are two types of calculator battery chargers — quick charge (restores pack in four to six hours) and normal charge (restores in 14 - 16 hours). Calculators requiring a quick charge rate should not be left on indefinitely. This runs the battery pack into excessive overcharge, and venting of the cells and premature failure of the battery pack may result.

A good rule of thumb, in either case, is to terminate the charge cycle when a perceptible rise in temperature occurs in the pack. If your battery fails to produce a little heat after the normal charge cycle with the calculator turned off, check your charger to see that it is actually putting out the correct amount of current. The usual failure mode in chargers is a broken cord.

We stock AA NiCd batteries in Central Stores under part number 14016. This is a quick-charge battery suitable for all types of hand-held calculators. **Do not** use General Electric GC-1 or Radio Shack 23-125 batteries in calculators unless you are sure your charger puts out no more than 45 mA, and your instructions say to charge for 14 to 16 hours for a full charge with the calculator turned off.

For more information on batteries, contact **Byron Witt, (58-299), ext. 5417.**

Line receiver, driver handle RS422-423

Two new components have recently been part-numbered to handle the new interface standards RS422 and RS423.

The quad line receiver, 26LS32, may be used differentially for RS422 or single-ended for RS423. There are three approved sources for this device — AMD, TI and National.

The line driver is the AM26LS30 or DS3691, from AMD and National, respectively. The device may function in a dual-differential or quad-single-ended mode. Slew rate control is provided.

The first implementation of these devices, by Dave Buxton in MDA, may be strapped for RS232, RS422 or RS423. Thus, these devices are a good choice for new designs for low- and medium-speed applications.

The 26LS32 has Tek P/N 156-1315-00. The AM26LS30/DS3691 is 156-1316-00. Contact me on ext. 6303 if you have any questions.

Jim Howe

Electrolytic cap failures analyzed

Failures of aluminum electrolytic capacitors represent 2% of total in-warranty component failures in Tek instruments. In an effort to reduce the field removal rate of these parts, Lynn Kung of Component Reliability Engineering performed failure analyses on more than 400 parts returned from service centers. The information from this analysis was useful in devising qualification procedures and incoming lot sample tests to detect lots having poor reliability. Such a lot sample reliability test has now been developed and is being put into use (see article on lot sample testing, page 12).

procedures

Each returned electrolytic capacitor was analyzed and results were recorded on a failure analysis record sheet. The procedure consisted of:

(1) A visual inspection for obvious manufacturing defects or failure modes — burned, exploded, leaking, etc.,

(2) electrical testing for capacitance, dissipation factor and DC leakage current, and

(3) disassembling the part to observe its internal condition.

results

Of 453 aluminum electrolytic capacitors returned and analyzed, the failure mechanism distribution was:

Leaking electrolyte	60%
Internal corrosion	17%
Shorts	12%
Other	11%

discussion of failures

The leaking electrolyte problem is insidious because it can cause fires and secondary damage to the circuit board, as well as destroying customer confidence. The leaking electrolyte parts fall into distinct, vendor/date-code categories.

For example, one bad lot of 290-0571-00 date-codes 7508 and 7509 accounted for 40% of all returned electrolytic capacitor failures. This indicates a lot sample test for seal integrity would be effective in reducing field failures.

Another type of problem is internal corrosion due to introduction of chemicals (usually freon). This failure mechanism was noted on 17% of returned parts by observing the condition of the foil. However, washing these parts in freon has been minimized, and this failure mechanism is expected to decrease in the future.

The third failure mechanism noted was internal shorts (12% of total). These failures are usually the result of the anodic lead tab inside the can being cut too long. With enough vibration and time, the lead tab touches the side of the can and shorts the part. Screening for this mechanism is prohibitively expensive because it would be necessary to vibrate the parts to induce failures. The best way to reduce this type of failure is to monitor plant and field failures and work directly with part manufacturers to ensure reliability.

conclusions

A reliability lot sample test which subjects a sample of incoming lots to an 85°C bake for 200 hours has been developed (see Tektronix Standard 062-4032-00). Purchase specifications for 39 large can, aluminum electrolytic capacitor types are being modified to reference this Tek standard. This test is quite effective in detecting lots which have leaking seals. Several lots of capacitors have already been rejected using this test.

Plans for FY000 call for extending this incoming reliability lot sampling test to cover over 100 part types. The benefit of this action will be an estimated 50% (minimum) reduction in aluminum electrolytic capacitor field failures. This represents a savings of approximately $30,000 per year in warranty repair costs (calculated at $150 per failure).

For further information on this subject, contact **Larry Meneghin or Lynn Kung at 58-176, ext. 7268.**

Electronic Equipment Reliability

Editor's note: This article is reprinted from the January, 1979, issue of the **Hewlett-Packard Journal.** *The author is Paul Baird, HP's Corporate Assurance Engineering Manager.*

Many of our modern electronic products are feasible because advances in reliability accompanied those of technology and invention. Computers, for example, made relatively slow progress until semiconductors replaced vacuum tubes. Then prices came down while reliability improved greatly.

Reductions in price for a given performance have tended to mask the improvements in reliability that are taking place. The reason is that we commonly look at the cost of maintaining a product as a percentage of its original price. Thus the manufacturer is kept under constant pressure to meet customers' expectations with regard to reliability. Actually, this is healthy since, by meeting those expectations, powerful new products can win acceptance.

in search of reliability

Reliability can be defined as the probability that a randomly selected product will successfully complete an assigned mission. It depends upon product robustness, mission stresses, mission duration, and product age (history).

It is fairly common practice among those concerned with electronic equipment to ignore the effects of product aging and use mean-time-between-failures (MTBF) as the measure of reliability. With such a model the reliability of a repaired product is no better or worse than that of one that has never failed.

This isn't quite true – most products become more reliable with age, at least for several years.

Also, because of the applicable mathematical relationships, most engineers prefer to key their discussions on failure rate, denoted λ, rather than upon MTBF. The probability that a product will fail in a time ΔT is approximated by $\lambda\Delta T$ so that the smaller λ is, the more reliable the product is. Additionally, for nearly all products (excepting those where redundancy techniques can be justified), $\lambda_{product} = \Sigma\lambda_{devices}$. These relationships hold whether or not λ's are time dependent, so we have left open our option to use sophisticated models for λ if we choose to do so. Additionally, if the product λ does not change much with aging we can state $MTBF = 1/\lambda_{product}$.

Since it is normally true that $\lambda_{product} = \Sigma\lambda_{devices}$ the use of more devices means a higher failure rate unless certain countermeasures can be implemented. These countermeasures are extremely important and are the subject of the following discussion.

in the design phase

Although nearly all field failures appear to be caused by a device, most are design- or manufacturing-controllable. The graphs below illustrate how product failure rate can be expected to vary as a function of certain design-controllable factors. As the graphs show, large design margins result in smaller λ's since the product will not be very sensitive to drift in device parameters (design margins are easily checked by non-destructive perturbation of internal variables, such as supply voltages, noise, clock rates, etc.). An improved technology may increase the design margins and it may also reduce the number of devices, resulting in lower λ's. Error correction involving redundancy, though effective, is practical at present only in very complex digital products. However, reducing temperature and electrical stresses can be particularly effective countermeasures because λ is very sensitive to these stresses. Through application of these relationships, the designer can have a powerful influence on the resulting product reliability.

materials management

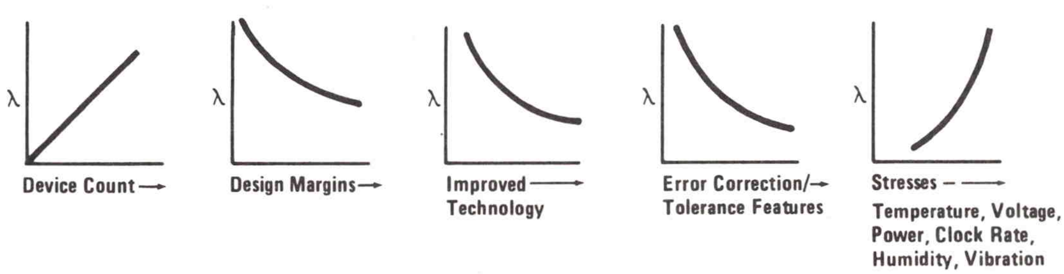
There is a residual set of potential failures that are best controlled by device selection. Vendors frequently offer more than one level of quality so some control is possible by this means. Then too, the quality of a device varies from vendor to vendor and sometimes from the same vendor at different times. Thus, qualifying a vendor, such as destructive stress testing of device samples and use of incoming shipment acceptance procedures through some form of inspection, are quite important. Vendors also do better as they gain experience with their own products.

Experience has shown that the failure rates of most devices improve with age, even over a span of several years. Thus, another way to improve λ is to accelerate the normal aging process, usually referred to as burn-in.

manufacturing

Following the selection of materials, some control over product λ is exerted by the manufacturing process. The manufacturing task is to avoid workmanship flaws. Some of these may be latent, allowing the product to work long enough to pass final inspection. Workers basically want to do a good job so enlistment of their active support through attention to their needs has a positive effect. Proper training is also important. Motivation and training produce best results, however, when proper tools are available. As an

continued



example, many HP divisions have electronic tools that check the tolerance of each component after it is loaded on a printed-circuit board to assure that it is still within tolerance following the mechanical stresses of insertion and the heat stresses of soldering.

after-sale support

Service support is a crucial item in how users feel about product reliability. If repair turnaround times are short and the cost per repair is low, customers tend to feel as if λ were lower than it really is. Since turnaround time and cost often conflict, service strategies are often devised according to the product type. Computers, for example, are usually serviced on-site because of the economic importance of very fast turnaround time in this area.

Customer training can reduce "cockpit" errors that lead to downed instruments. Good operating and service manuals also have a positive influence here. In addition, implementation of proper preventive maintenance can reduce some types of hardware failures.

active product assurance

Reliability is only partly technology-limited. It is also likely to be limited by cost tradeoffs and by attention to detail in competition with other work objectives, so it is highly influenced by management commitment to reliability.

To achieve low λ in their products, many companies are willing to commit the resources needed to establish product assurance departments. At Hewlett-Packard, product assurance managers, most of whom have had broad experience in other departments, provide the following services:

- To act as a participant or else catalyst in the tasks already named.
- Act as a conscience.
- Provide information relative to quality and reliability.
- Assure that somehow the proper things are happening.
- Do quality and reliability engineering.
- Assure compliance with the product safety and electromagnetic compatibility regulations of the various nations where HP products are sold.

Some of the major assurance techniques are listed here:

Area	Techniques
Design	▶ environmental testing
	▶ life testing
	▶ setting goals
	▶ margin testing (Schmoo plots)
	▶ component stress analysis
	▶ failure rate estimation
	▶ anticipating abuses
Materials	▶ stress testing
	▶ component screening
	▶ failure analysis
	▶ process change reviews
	▶ incoming inspection
	▶ vendor performance tracking
	▶ specifications
Manufacturing	▶ sales inspection
	▶ warehouse audits
	▶ warranty analysis
	▶ control charts
	▶ production failure analysis
	▶ environmental requalification
	▶ process control
	▶ metrology
Service	▶ control of turnaround time
	▶ delivery time of spare parts
	▶ customer training
	▶ control of mean time to repair (MTTR)
	▶ audits of instruction manuals
	▶ information feedback

results

Looking ahead we expect to benefit from both statistical and physical approaches to reliability. Statistics help set priorities by quantifying problems and relationships. At HP, very complete records are kept of warranty information about each serialized product, detailing such items as ship dates, fail dates, repair office, labor hours, turnaround time, a list of parts replaced (with failure codes), total cost of repair, and free-form comments by the customer engineer.

Very useful analyses can be derived from this data base to pinpoint troublesome models, components, or geographical areas. Data is even complete enough to fit time-dependent Weibull failure models to both products and components, which is done regularly.

After statistical definition of top problems we can concentrate upon understanding the fundamental relationships in terms of physics, chemistry, manufacturing processes and design stresses. Most of HP's major divisions are devoting resources to high-stress experiments on components followed by failure analysis of devices that don't pass. Electromigration, for example, is a failure mechanism now pretty well understood and controlled. On a selective basis, failure analysis is also done on devices failing in environmental tests, life tests, the factory floor, or in field use. Where practical, results are shared on a company-wide basis. We have, for instance, an ALERT system that can be activated by any division to warn the others of a possible problem. The ALERT also contains a recommendation for dealing with the situation. As a result, some problems are disappearing.

Reliability excellence in a product results from care in the design of the product, in the choice of materials, and in the manufacturing processes, like the links in a chain. The weakest link determines how the product will eventually fail, so careful attention must be paid to all. Recent trends have been toward a reduction of both product failure rates and costs and further improvements can be expected.

submitted by Bill Pederson
FDI Reliability Engineer

4K RAM life test results

A reliability evaluation of the plastic and ceramic package types of the 4027 4K dynamic RAM from Mostek (Tek P/N 156-1027-00) has been completed. 100 samples of each package type were subjected to life tests at 125°C for 96 hours in a Microtest burn-in system. Tests were done on the S3455.

Life test results are as follows:

package type	number of failures at: 0 hrs.	16 hrs.	36 hrs.	96 hrs.
Plastic	0	1	2	0
Ceramic	0	0	0	1

Projected failure rates at 70°C (% per 1000 hours) are:

package type	raw parts	electrically tested	96 hour burn-in
Plastic	0.36	0.36	0.08
Ceramic	0.17	0.17	0.08

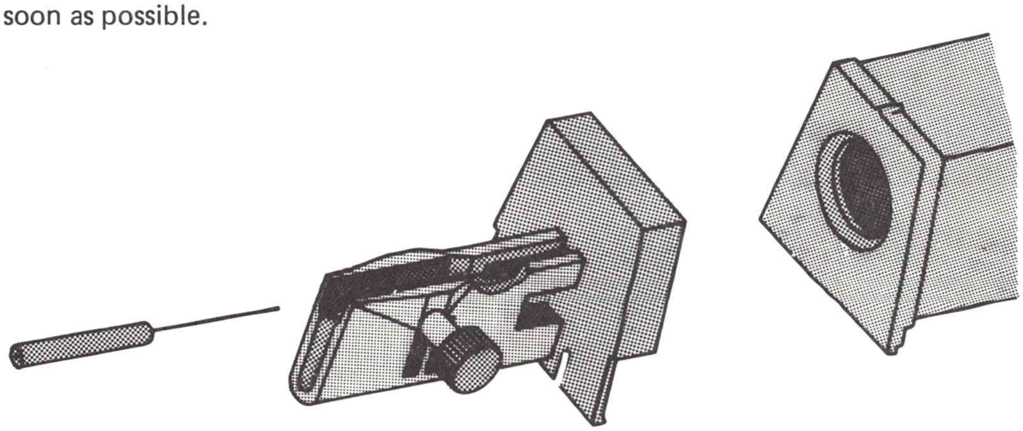
From the life test results and estimated failure rates, ceramic parts do offer higher reliability. It is also apparent that burn-in would result in a lower failure rates.

Steve Hui, ext. 6511
Component Reliability Engineering

Fiber optic to probe adapter

For customers who would like to use the J16 photometer for fiber optic measurements, Tek has designed an adapter to connect a typical fiber optic cable or fiber to a J16 probe. We need comments from users as soon as possible.

Prototype adapters are available now (see illustration). If you have the need to make fiber optic measurements, and could use an adapter, please contact **Louis Mahn, ext. 6389.**



Reliability lot sample testing

How about decreasing transistor warranty failures by 25% with no mods or price increase! Lot sample testing can do that and more. Component Test Engineering is helping develop a program to test transistor reliability at Incoming Inspection much the same way electrical parameters are verified. Previous monitoring indicates that most shipments have very good reliability but occasional bad lots cause heavy warranty failures.

Based on MIL STD-750, Method 1039, the first sample test involves burning-in a sample of electrically checked parts and noting the number of failures. Reject lots go back to the vendor. This system is particularly effective for high-volume, low unit cost, multiple-sourced parts, and is estimated to have a 60% "return on investment."

Ron Schwartz's Component Reliability Engineering group has added reliability requirements to over 60 transistor specifications representing 75% of Tek's annual usage. A proposal for the burn-in equipment is complete and waiting for approval.

The critical link in the program, yet to be worked out, is a change in the Tektronix inventory control strategy. Because there must be sufficient cushion to allow return of defective lots, inventory increases are essential. Additional inventory hold costs are minor compared to warranty cost savings.

Although instrument quality is dependent on many complex factors, probably the single most important is semiconductor reliability. Reliability lot sample testing is a cost-effective way to positively impact the Tek "Commitment to Excellence."

If you have questions or comments, call Gary Veatch (ext. 5036), or Ron Schwartz (ext. 6511).

Gary Veatch
Component Test Engineer

Before buying test equipment...

The buyer of new test equipment is often faced with several, apparently equal, choices. One example is the digital voltmeter field, where competition among many vendors is keen.

Often, we at Primary Standards can assist you in making these instrument-related decisions. We have a good overview of many instruments as to maintainability, reliability and vendor support. Sometimes we are even able to translate the specifications into something meaningful! We invite you to call ext. 5540 or 5397. Someone will try to assist you.

Gene Brox
Calibration/Certification Lab supervisor

CORRECTION

The article on liquid crystal displays in **Component News 267** (pages 11-12) stated that the humidity test for Class 3 instruments went up to 55°C at 95% relative humidity. Actually, the Class 3 test goes up to 60°C at 95 - 97% RH. This is per MIL-STD-810C.

The Class 5 instrument test also goes up to 60°C, but the humidity is only 90 - 95%. Please contact me if you have any questions concerning these humidity tests.

Betty Anderson, ext. 6389

"Ceramic Only" packages not included

Packaging material deleted from μCircuit specs

In order to simplify microcircuit specifications, the title page of our specs will call out **nothing** if the packaging material is plastic. "Ceramic Only" packages are not included in this plan, and will still be described as such on the specification.

For example, the specification description for a plastic-packaged device would be:

MICROCIRCUIT, DIGITAL; QUAD 2-INPUT NAND GATE, 74S00; STTL, 14-PIN DIP.

However, on the Purchased Item Source List (PISL) we will call out both plastic and ceramic materials (if both are available and approved). For example:

MANUFACTURER	MFG. CODE	MANUFACTURER'S PART NUMBER
TEXAS INSTRUMENTS INC.	01295	SN74S00 N or J
NATIONAL SEMICONDUCTOR	27014	DM74S00 N or J

(N or J: denotes packaging material)

If you have any questions about this procedure, please call me on ext. 7262.

Bruce Brown

Letter to the Editor

To the editor:

Peter Butler recently wrote an article for **Component News** where he put the "rap" on IC sockets. As a result, he has received a great deal of criticism from maintenance and repair groups who prefer the "easy-in, easy-out" approach for replacing components.

At best, active components are designed to be soldered directly into boards. To further encumber them by creating a greater potential for failure is guaranteeing just that — a failure! Active component and socket manufacturers (even within the same company) cannot come to terms with this problem . . . and no quick solution is in sight.

So why delude ourselves further? We can either accept the failure rate in our instruments, or do something positive about it!

We could drastically reduce the number of sockets we use for active components, or remove them altogether. Also, reducing the number of interruptible connections inside our instruments (i.e., square pins and receptacles) would greatly improve overall reliability. However, we must be able to look beyond "quick and dirty" troubleshooting, and consider the benefits and advantages of direct IC insertion.

For example, soldered-in ICs would provide lower total I_R drop, cooler circuits and better airflow, more space and reduced weight, less assembly labor, fewer part numbers and *lower cost.* Finally, consider that you don't have to troubleshoot defective connectors that aren't there!

Larry Berry
SPECS Engineering

New Component Engineer

Dale Hartman has joined the Electromechanical Component Engineering group, and will report to Bob Aguirre. Dale's initial duties will be to provide technical support to manufacturing and purchasing groups for wire, cable and harness assemblies. Before joining CE, Dale worked in the Hybrid Circuit Engineering Packaging group in Tek Labs.

You can contact Dale at 58-299, ext. 5953.

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	No.	Description	When available	Tek P/N	Approx. cost	Engineer to contact
		analog devices				
H-P	5082-0008	Diode Chip, step recovery, 80 pS	now	in process	$9.00	Gary Sargeant, 5345
Moto, Amperex	BAV99	Diode Pair, Series, SOT-23	now	152-0731-00	.23	Gary Sargeant, 5345
Moto, Amperex	BAW56	Diode Pair, Common Anode, SOT-23	now	152-0735-00	.18	Gary Sargeant, 5245
Moto, Amperex	BAV70	Diode Pair, Common Cathode, SOT-23	now	152-0736-00	.17	Gary Sargeant, 5245
Moto, Amperex	BZX84-C5V6	Diode, Zener, 5.6V, SOT-23	now	in process	.17	Gary Sargeant, 5245
Motorola	MMBD914	Diode, Single, SOT-23	now	152-0734-00	.16	Gary Sargeant, 5245
Motorola	MMBV101	Diode, Schottky, SOT-23	now	in process	.30	Gary Sargeant, 5245
Motorola	1N3890R family	Diode, 12A, fast recovery, reverse polarity, DO-4	now	in process	1.40	Gary Sargeant, 5245
		digital devices				
National	MM5369	Oscillator/Divider, 60 Hz, 17-stage programmable	now	in process	1.75	Wilton Hart, 7607
		electromechanical devices				
Zepher	--	Cable, ribbon, 34 cond, IDC connectors, 2" long	now	175-2456-00	5.00	Rod Christiansen, 5953
--	--	Aluminum bar, 1.0" sq., Alloy 6061-T6	now	251-1602-00	1.00/lb.	Rod Christiansen, 5953
--	--	Aluminum bar, 1.0 x 0.125", Alloy 2024-T4	now	251-1603-00	2.33/lb.	Rod Christiansen, 5953
		optoelectronic and passive devices				
RIFA	PMR2026	Capacitor, 0.1μF, 600VDC, 22Ω resistor in series	March	in process	--	Don Anderson, 5415
Mallory	CGS	Capacitor, electrolytic 1600 μF, 200V, 4.5A RMS ripple current	soon	in process	--	Don Anderson, 5415

Glossary of Reliability Terms

This glossary is not intended to have universal applicability but rather is intended to define some of the terms commonly used at Tektronix. The definitions were compiled from various sources, and some were paraphrased to eliminate unnecessary military jargon.

- **Accelerated test** — A test in which the applied stress level is chosen to exceed that stated in the reference conditions in order to shorten the time required to observe the stress response of the item, or magnify the response in a given time. To be valid, must not alter the basic modes and mechanisms of failure and their relative prevalence in a use situation. (IEC 271)
- **Burn-in screen** — Performed for the purpose of eliminating marginal devices, those with inherent defects or defects resulting from manufacturing aberrations which are evidenced as time and stress dependent failures. Burn-in is usually performed by applying maximum rated, operating conditions for a specified time period. (MIL-STD-883A, method 1015)
- **Electrical tests at elevated temperature** — Usually a DC electrical and full functional test performed at a temperature above ambient (Typically 70°C or maximum rated operating temperature for IC's, and 125°C for transistors tested at Tektronix on the hot track.)
- **Failure** — The inability of an item to perform within previously specified limits. (MIL-STD-790C)

  CLASSIFICATION OF FAILURE AS TO DEGREE — (MIL-STD-790C)

  partial failure — failure resulting from deviations in characteristic(s) beyond specified limits but not such as to cause complete lack of required function.

  complete failure — failure resulting from deviations in characteristic(s) beyond specified limits such as to cause complete lack of the required function.

  intermittent failure — failure of an item for a limited period of time, following which the item recovers its ability to perform its required function without being subjected to any external corrective action.
- **Failure activating cause** — The stresses/forces, such as shock or vibration, which induce or activate a failure mechanism. (MIL-STD-790C)
- **Failure analysis** — The process of examining parts to determine the cause of variations of performance characteristics outside of previously established limits with the end result that failure modes, failure mechanisms and failure activating causes will be identified. (MIL-STD-790C)
- **Failure mechanism** — The physical process by which the degradation proceeded to the point of failure, identifying quality defects (including the original defect which initiated the device failure), internal, structural, or electrical weaknesses and, where applicable, the nature of externally applied stresses which led to failure. (MIL-STD-883A)
- **Failure mode** — The cause for rejection of any failed device as defined in terms of the specific electrical/physical requirement which it failed to meet. (MIL-STD-883A)
- **Failure Rate** — The number of items replaced per unit of time due to failure of that item, normally expressed in % failures per 1000 hours of operation, or in number of failures per million hours of operation.
- **Functional tests** — Defined as go, no-go tests which sequentially exercise a function (truth) table or in which the device is operated as a part of an external circuit and circuit operation is tested. (MIL-STD-883A)
- **High temperature reverse bias** — (HTRB) - A reverse bias, less than breakdown voltage, is applied to one or both transistor junctions at elevated temperature to promote infant failures.

- **High temperature storage (stabilization bake)** — The purpose of this test is to determine the effect on micro-electronic devices of storage at elevated temperature. This test is primarily used for device stabilization and the detection of parameter drift. It also is useful in accelerating temperature dependent failure mechanisms such as those resulting from chemical reaction or diffusion. (MIL-STD-883A, method 1008)

- **Intermittent life (or power cycling)** — Performed for the purpose of determining a representative failure rate for micro-electronic devices or demonstrating quality or reliability of devices subjected to the specified conditions. It is intended for applications where the devices are exposed to cyclic variations in electrical stresses and power consumption between the "on" and "off" condition and resultant cyclic variations in device and case temperature. The test can be performed under various conditions ranging from DC reverse bias to operation under high power conditions. (MIL-STD-883A, method 1006)

- **MTBF (Mean Time Between Failures)** — The average time of operation between failures of an item, expressed in hours. MTBF is the reciprocal of the failure rate.

- **Observed failure rate** — For a stated period in the life of an item, the ratio of the total number of failures in a sample to the cumulative observed time on that sample...to be associated with particular and stated time intervals and with stated conditions (IEC 271)

- **Power cycling** — see intermittent life

- **Preconditioning** — The application of stress to a group of components which is done prior to screening (100% testing). This treatment is intended to promote the failure of intrinsically weak devices so they can be detected by screening.

- **Quality** — The degree of conformance to applicable specifications and workmanship standards at the time of the quality inspection, OR The percentage of defective units (either dead-on-arrival or out-of-spec) furnished by the supplier to the user.

- **Reliability** — The probability of a device performing its purpose adequately for the period of time intended under the specified operating conditions.

- **Reliability assurance** — The management and technical integration of the reliability activities essential in maintaining reliability achievements, including design, production and product assurance. (MIL-STD-790C)

- **Sample** — A random selection of units from a lot for the purpose of evaluating the characteristics or acceptability of the lot.

- **Screening** — A test, or combination of tests, (performed on 100% of a group of parts) intended to remove unsatisfactory items or those likely to exhibit early failures. (IEC 271)

- **Stabilization bake** — see high temperature storage

- **Stress** — Voltage, power, temperature, or thermal environmental conditions during component testing or usage which affect the failure rate, and hence the reliability of the parts.

- **Temperature cycling** — This test is conducted to determine the resistance of the part to exposures at extremes of high and low temperatures. Permanent changes in operating characteristics and physical damage result from variations in the physical properties and dimensions during test. This test is often used to screen for devices with weak mechanical properties. (MIL-STD-883A, method 1010)

- **Thermal shock** — The purpose of this test is to determine the resistance of the device to sudden, extreme changes in temperature. It is useful for evaluating mismatches in thermal time constants and expansion coefficient between various device materials. (MIL-STD-883A, method 1011)

COMPONENT CHECKLIST

The "Component Checklist" is intended to draw attention to problems or changes that affect circuit design. This listing includes: catalog and spec changes or discrepancies; availability and price changes; production problems; design recommendations; and notification of when and how problems were solved. For those problems of a continuing nature, periodic reminders with additional details will be included as needed.

Tek P/N	Vendor	Description of Part	Who to Contact
156-0281-00	RCA	Transistor array	Matt Porter, ext. 7461

RCA can no longer meet the specification on this part and, due to their internal processing problems, have decided to discontinue production. This array is a gold-doped, high-speed core driver with turn-off times of less than 60 nS. The part RCA is offering as a substitute is the non-gold-doped version of the part, and it has substantially slower switching speeds (t_{off} = 1 μS, compared to t_{off} = 60 nS for the old part).

At this time, most applications of this part are for a fan motor circuit in the 400- and 7000-Series instruments. There is a possibility that these instruments can still use the slower parts, though. If you know of any new applications for this part, or any existing applications other than the fan motor circuit, please contact me.

151-0410-00 Texas Instruments Transistor — **Matt Porter, ext. 7461**

This has been a problem part since 1972. Our current vendor can no longer meet the bandwidth and capacitance specifications. This is a 200 MHz, 60 V high Beta transistor. TI can only sell us a 150 MHz part at this time, and their future supply does not look good. In addition, all other available sources are unable to supply the part. To date, we have inquired to Motorola, Fairchild, National, Sprague, Nucleonic Products, Nippon Electric Co., Raytheon and RCA.

All users of this part are urged to use a different transistor, if possible, according to their circuit needs. The 151-0410-00 will probably remain a problem part with only one source forever.

Possible replacement parts are listed below:

P/N	f_T	BV_{CEO}	Beta
151-0219-00	100-150 MHz	25 V	>250 5 V, 0.1 - 10 mA
151-0276-00	100-150 MHz	50 V	>250 5 V, 0.1 - 10 mA
151-0216-00	170 MHz	25 V	300 10 V, 2 mA 150 10 V, 0.1 mA

TECHNICAL STANDARDS

The function of Technical Standards is to identify, describe, and document standard processes, procedures, and practices within the Tektronix complex, and to insure 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 (58-187)*

information on Vol. 1 Standards

Standards H-112, Overlay, Draw Dies, and **H-113,** Subpanel Draw Dies, are being discontinued. Historical copies will be retained in Technical Standards files for reference if needed.

Standards L-110, L-111, and L-112 (Machine Screws) will not be rewritten as part-numbered standards, and will not be listed in the forthcoming revision of the Directory of Standards. The Common Design Parts Catalog '2' contains the discontinued material.

new publications available

Technical Standards has a new supply of Plastics World "Guide to Plastics Properties" wall charts from Shell Oil Company available for distribution.

The latest issue of NASA Briefs includes articles on Electrical Components and Circuits, Electronic Systems, Physical Sciences, Materials, Life Sciences, Mechanics, Machinery, Fabrication Technology, and Mathematics and Information Sciences. NASA Briefs may be borrowed from Technical Standards.

new service from Technical Standards

Technical Standards is now providing loan-out of most of the standards and other documents listed in the computer index of reference documents. There is a copy of the index at all plants.

for information on the above publications, please call Carol Whitmore, Technical Standards, ext. 7976.

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