component news

June 6, 1980 COMPANY CONFIDENTIAL Issue 281

Regulators Indestructible! (Almost)

The LM317 (156-1611-00) is a three-terminal voltage regulator, adjustable from 1.2V to 40V with two external resistors. It is capable of regulating up to a 1.5A load with proper precautions. The LM317's versatility, coupled with cost competitiveness and improved design features, has resulted in a marked increase in use here at Tek. The part therefore warrants the necessary characterization to determine acceptable alternate sources.

Samples were obtained from Texas Instruments and Fairchild for evaluation. National Semiconductor, the current supplier, was also evaluated for comparison. Motorola and Silicon General will be considered when parts arrive.

Regulators examined

Essentially, most regulators can meet published specifications under a controlled "test" environment, where mild conditions do not stress the part. But, the true test of a voltage regulator comes when the part is stressed to its extreme processing limits and is still able to sustain abuse. Such conditions occur in many Tek applications, and the parts must still meet reliability requirements.

The focus of this article is to examine the characteristics of the LM317 under stress conditions which occur in the field.

Testing the regulator in fault modes

The 317 voltage regulator has protective circuitry on the chip to improve reliability and to make it immune to certain types of overloads. This protects against short circuit conditions *(current limit)*, against output of excessive current at high input/output voltage differential conditions *(safe area protection)* and against excessive junction temperatures *(thermal shutdown)*.

Current limit and safe area protection

Current limit is set internally at about 2.0A, and remains relatively constant (±10%) with temperature. Also included is safe area protection for the pass transistor, which decreases the current limit as input-to-output voltage differential increases, thus preventing secondary breakdown in the transistor. The safe area protection circuitry in the 317 allows full output current up to about 15V differential, and limits the current at higher voltages. The current limit does not drop to zero at high input-to-output differential voltages, thereby preventing start-up problems with the high input voltages. Figure 1 (page 2) displays characteristics of the three vendors tested. Note from Figure 1 that TI's LM317s fail during high transient current at about 35V differential. The spec limit is 40V.

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Also in this issue

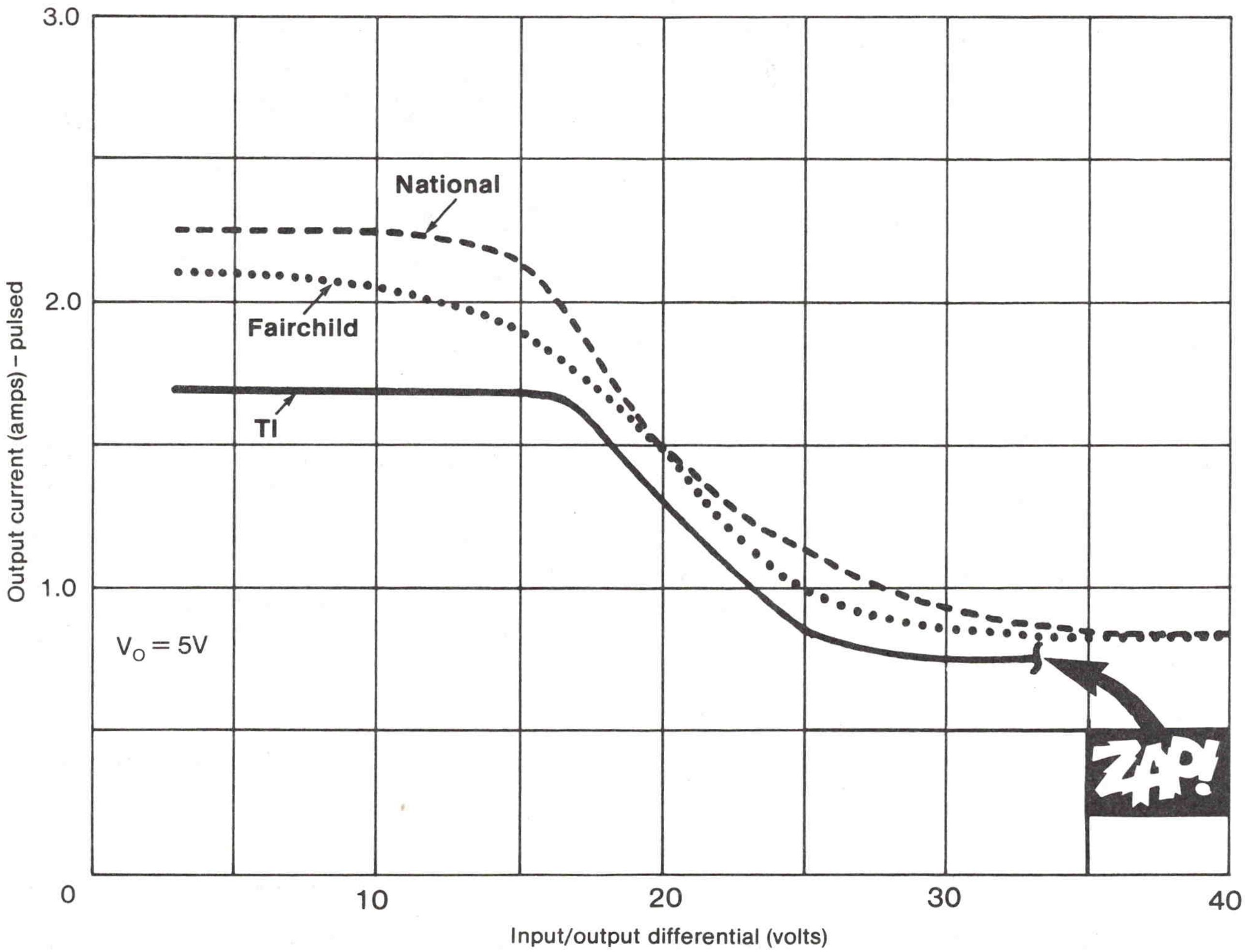

Figure 1 — Current limit vs. input/output differential – LM317

TI's failure to operate above 35V at high transient currents is due to secondary breakdown of the power output transistor. Secondary breakdown of a transistor occurs because of non-uniform current distribution within the transistor junctions at high power levels. This causes non-uniform heating and formation of localized "hot spots." If the junction temperature under a given current and voltage level reaches a "triggering temperature," the power device goes into secondary breakdown and becomes a virtual short circuit. Secondary breakdown is mostly a function of voltage. Therefore, a transistor's power rating is not only limited to its thermal capacity, but also on bias conditions.

Examination of the die shows that TI's power transistor structure is the same as National's. Figure 2 is a microphotograph of National's LM317. "Ballast" resistors in series with each one of the individual emitter areas are used to reduce the effects of non-uniform current distribution (see Figure 3). *TI's attempt to protect against secondary breakdown is unsatisfactory,* probably due to a difference in processing techniques.

Thermal shutdown

Thermal overload protection, included on the chip, turns the regulator off when the chip temperature exceeds ~170°C, preventing destruction due to excessive heating. Samples tested from all three vendors shut down due to excessive power dissipation. The shutdown circuitry performed properly.

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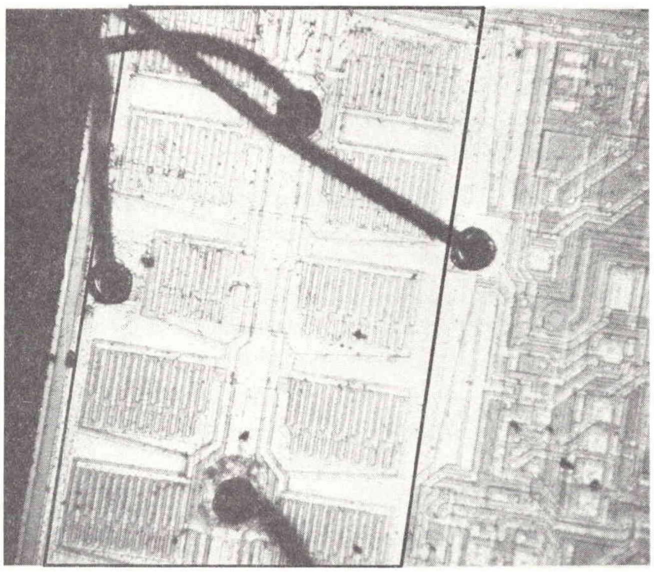

Figure 2 — Shows power transistor structure for National's LM317.

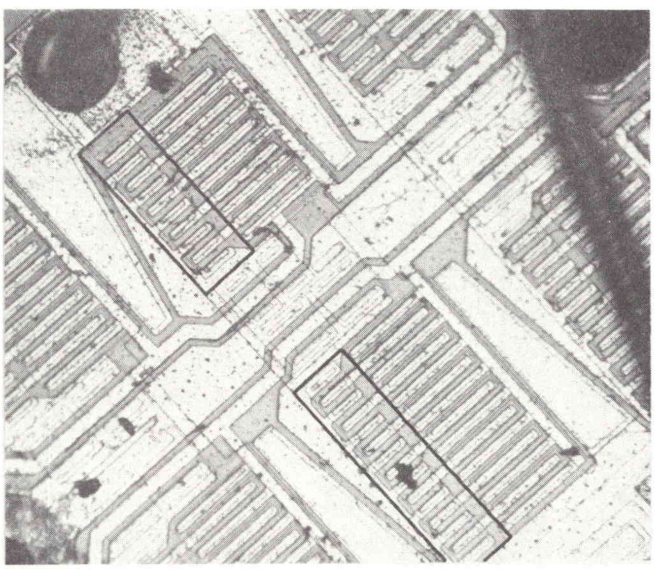

Figure 3 — Exploded view of Fig. 2 showing "ballast" resistors.

Load regulation: thermal and electrical responses

The devices were set up as a 5V regulator with 10V input. A 1A pulse load was applied and scope photos were taken of the results (see Figure 4, page 4).

TI's load regulation is grossly different from National's and Fairchild's. The large output change in the TI devices is due to poor thermal gradient rejection. Thermal gradients occur when power is dissipated in one area of the die and causes a temperature gradient across the die (see Figure 5). The various components of the reference circuitry now are no longer at a single temperature, so small thermally-induced shifts occur in the reference voltage. These shifts are then reflected to the output as a change in output voltage in response to a change in dissipated power in the pass transistor. Therefore, both load and line regulation for an integrated voltage regulator are determined by a thermal response and an electrical response.

Notice in Figure 5 that National and Fairchild do not exhibit an exponential thermal response. Good layout design which places critical components along constant isotherm lines prevents thermally-induced offset voltages. Note also that TI's parts are dominated by thermal responses.

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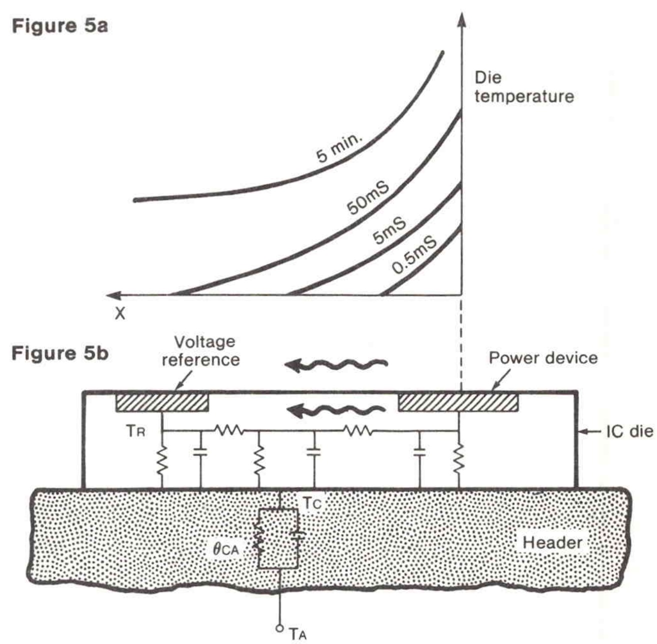


Figure 5a — Plot of temperature across the die after power transistor is turned on.

Figure 5b — A simplified thermal model of IC power regulator mounted to a header.

Conclusion

At this time, TI will not be considered as an alternative source because of its failure to current limit at high input voltage, and its poor voltage regulation due to thermal response. A qualifying order will be placed with Fairchild and some of the parts will be given an accelerated life test.

If you have any questions about the 317 voltage regulator, please contact me at 78-557, ext. DR-2540.

Chris Martinez
Analog Component Engineering

Figure 4 — Output load regulation

V_O=5V, V_{IN}=10V, I_L=1A (pulsed)

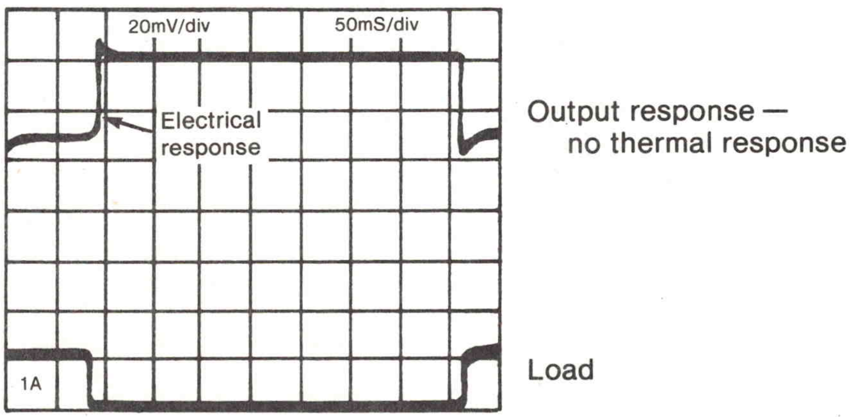


Figure 4a — National LM317

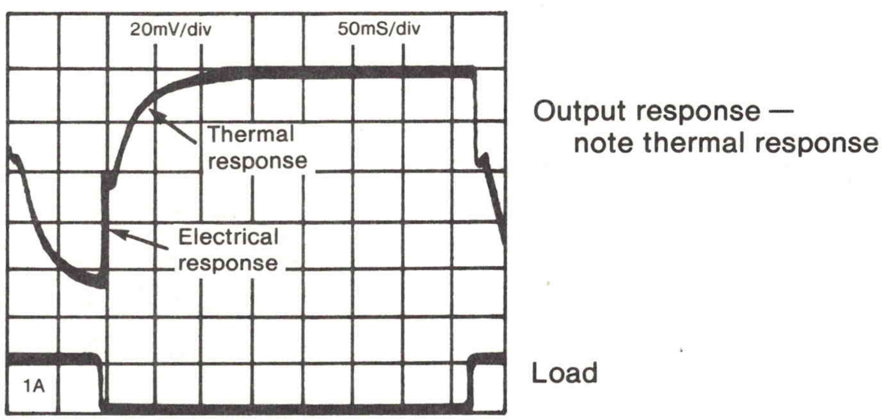


Figure 4b — Texas Instruments LM317

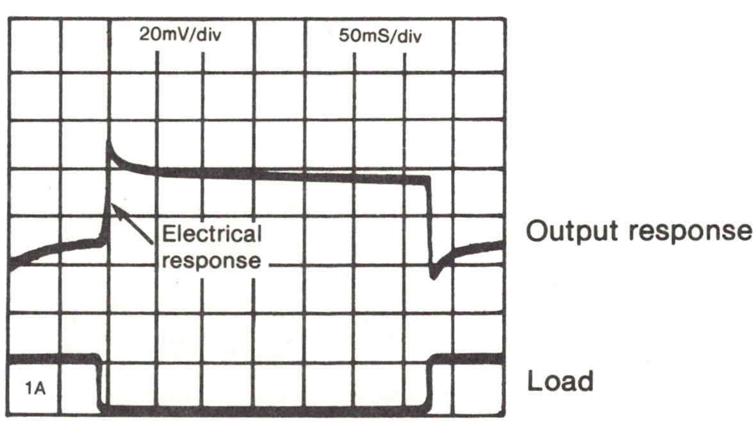


Figure 4c — Fairchild μA317

Redesigned GPIB controller evaluated

The newly redesigned TMS9914 GPIB controller has been evaluated in Component Engineering. Each known 9914 bug was searched for in the new chips.

The 'BO' interrupt bit now clears on a write to the data-out register, as well as on a read of the interrupt status register. This clears up a potential problem of overwriting output data if the 'BO' interrupt status bit is true at the moment that the write to the data-out register occurs. Also, reading from the data-in register will clear the 'BI' interrupt bit.

The serial poll register is now implemented as a two-register set. The microprocessor writes the status byte to the master register; the status byte can only be transferred from the master register to the slave register when the 9914 is not in SPAS **and** when the write to register 5 is ended. This clears up two problems: the first being that data on the GPIB data bus could change while the chip was in SPAS AND STRS; the second being the fact that the 'rsv' bit could be momentarily set into a wrong state by bad data on the microprocessor data bus at the front end of a write cycle. (See Component Checklist for more information on Serial Polls.)

The 'rfdr' auxiliary command to register 3 will not now cause NRFD to go false 6 clocks after the write to register 3 has completed, eliminating a data over-run problem associated with older 9914's communicating with fast SH talkers. During evaluation, a 'rfdr' command of 8 clocks duration was given to the chip with no ill effect; NRFD was released six clocks after the write to register -3 ended. The data on the data bus was also allowed to change for a portion of the eight clock write cycle to register 3, with the discovery that only the data on the data bus at the end of the write cycle is used by the 9914 for auxiliary commands. However, if the Chip Enable or Write Enable glitches during the write to register 2, the results will be indeterminate. A glitch during the 'rfdr' command will cause data over-run.

The REM bit now functions according to the 1978 version of IEE488 when secondary addressing is enabled in that the transition from local to remote is made on 'MSA' (c/s=1 when 'dacr' is used) with LPAS true. The interpretation of 'MSA' in the 9914 is that it is an internal state, which is independent of the Acceptor Handshake, which lasts until six clocks have elapsed after the auxiliary command <'dacr' , 'msa'> has been stuffed into register 3 of the 9914. Therefore, it is important that when the 'dacr' command is used, the c/s bit **always** be false, unless responding to an APT interrupt with the intent of becoming addressed.

A new interrupt bit has been implemented called 'ERR' which is set if a write to the data-out register takes place while NRFD and NDAC are both false. The SH function will move from SDYS to a temporary state called SHERR, which causes the 'ERR' bit to be set. If the bus acceptor becomes active, the handshake will proceed normally. The bit 'ERR' is set on entry into the SHERR state, and clears on a read of the interrupt status register.

The 'UUCG' and 'UACG' interrupt status bits are now combined into a single bit, 'UCG.' Addressed Command Group and Unaddressed Command Group commands are distinguished by a single bit in the command which is read from the Command Pass through Register.

In evaluation, the device functions properly with $\overline{WE}$ effectively generated in the same manner as DBIN. There is no problem observed as a result of having $\overline{WE}$ true while $\overline{CE}$ is false. However, in 6800 systems, generating $\overline{CE}$ with $\Phi 2$ will allow the chip to be enabled for writes before data has set up on the data bus. This will adversely affect two bits — 'dal' and 'dat,' both in Address Register Four. Normally, this register is set-up once at power up. If it must be changed on the fly, $\overline{WE}$ going true for writes should be delayed until data is valid on the microprocessor data bus. These are the only known problem bits in the chip for data set-up, although the ACDS-holdoff interrupt mask bits may also be capable of causing problems in this way.

If the address $1F (31 Decimal) is written to the 9914, the chip will recognize UNT and UNL as MTA and MLA respectively. Therefore it is necessary to test the address switch contents prior to loading register 4. If a $1F (31 Decimal) is on the switch, the the 'dal' and 'dat' bits of the 9914 should be set to prevent the chip from becoming addressed.

The $\overline{ACCRQ}$ (DMA Request) line will be left true on exit from TACS. It will remain true until it is acknowledged; therefore it may be true on entry into LACS even if no byte has been accepted by the chip. If this is a problem, the $\overline{ACCRQ}$ line may be cleared by a dummy read of the data-in register while responding to the 'MA' holdoff interrupt for MLA prior to entry into LACS.

Jim Howe (63-211), ext. W1-3583

LIFETES: Computer program for life test data

LIFETES is a computer program for statistical treatment of life test data. It is on CYBER, and a User's Guide is available on request.

Reliability is an important design parameter of a component, the same as cost, size or electrical performance. This being the case, one of our tasks is to evaluate the degree to which the design goal has been achieved. The purpose of LIFETES is to facilitate this work.

The program does two things. First, it generates pseudo-data, having known underlying statistics, for you to practice on. Second, it accepts real life test data, and helps you estimate the underlying statistics.

Basic definition

The basic concept is that of the Hazard Rate function, h(t), defined by:

$$h(t) = \frac{1}{N}\frac{dN}{dt}$$

Where dN is the number of items failing during a time increment dt, and N is the number of items on test at the beginning of this time increment. For some components, h(t) does not depend on how long they have been on test. For other components, the hazard rate may increase as some power of the time, such as the square or the cube of the elapsed time. To estimate h(t) based on a set of test data, you can do it indirectly by estimating its integral, the Cumulative Hazard function H(T), defined by:

$$H(T) = \int_0^T h(t)\, dt$$

The reliability R(t) is then given by:

$$R(T) = e^{-H(T)}$$

The reliability R(T) at time T is defined as the remaining fraction of the items you started with. This is illustrated in Figure 1. In Figure 1a you can see h(t), which in this case increases linearly with time. The cumulative hazard is given by:

$$H(T) = \frac{T^2}{2}$$

and the reliability by:

$$R = e^{-(\frac{T^2}{2})}$$

1a

1b

1c

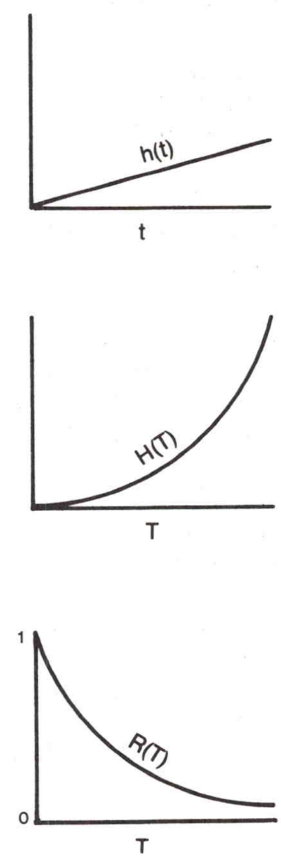


Figure 1 — Hazard function h(t) shown in 1a generates cumulative hazard H(T), which in turn leads to reliability curve R(T).

continued on page 7

Generation of pseudo data

One of the interesting properties of the reliability curve R(T) is that it is useful to play it backward as well as forward. This is illustrated in Figure 2. The usual problem is: given a reliability curve R(T), find the reliability at some specific time T_i. To do this, go to T_i on the X axis, move up until intercepting the curve, then move to the left until intercepting the Y axis, where the reliability R_i corresponding to time T_i can be read.

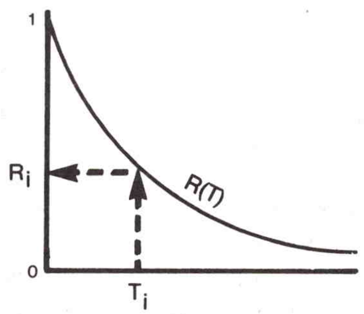


Figure 2 — Normal use of reliability curve. Given a time Ti, you can read off corresponding reliability Ri.

The reverse usage is shown in Figure 3. Enter on the Y axis with a randomly selected number between 0 and 1, say Uj, and proceed to the right until intercepting the curve, then descend to the Y axis and read off the corresponding time Tj. If you do this a number of times with input numbers from a uniform density distribution, then the density distribution of the output numbers Tj will be governed by the shape of the R(T) curve. By this means, you can generate a pseudo-data sample of failure times, for which you can be certain of the underlying hazard function. Thus, you are able to test your skills at estimating the underlying statistics of a real life test result.

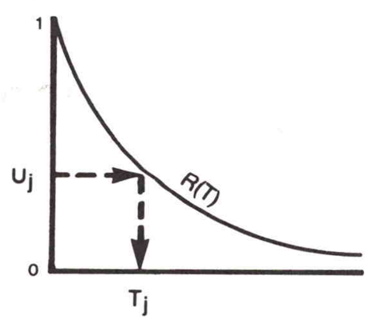


Figure 3 — Inverted use of reliability curve.

Suggested uses

The program can be used to study:

A) Sensitivity of the results to number of items tested, and to the time at which the test is terminated.

B) Range of underlying hazard parameters which may have generated a given test result.

C) Range of test results that might result from a given hazard function.

If you have any questions, or for a copy of the LIFETES User's Guide, please contact me at 78-552, ext. DR-2484.

Jim Deer
Electromechanical CE

Derating guidelines on CYBER

Many people have inquired about accessing the "Device Derating Guidelines" from CYBER. Here's the procedure.

1. To get the derating program for "on the screen" interactive usage, after logging on, type:

GET, DERATE/UN=ACAØLAM
DERATE

2. To get a hard copy of the derating guidelines, after logging on the CYBER, type:

GET,COPYD/UN=ACAØLAM
DISPOSE, COPYD/EI

The output will end up in the RJE queue. If you want the output to go to the SCC (Bldg. 50), just type:

DISPOSE, COPYD
(after the GET command)

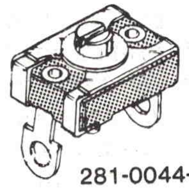
For more information, please contact **Ron Schwartz (92-336), ext. WR-1991.**

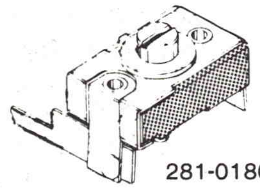
Values for mica trimmers changed

In the past, all of our variable mica capacitors were single-sourced to El-Menco. About 18 months ago they went out of business, leaving us with no approved source. Most of our requirements were filled by another company, but there are not many compression mica capacitor suppliers available. In addition, the suppliers that are available have already been considered, and most cannot meet our requirements.

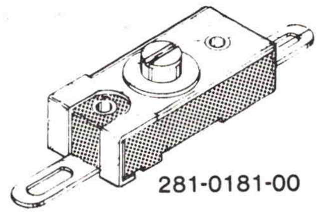
Because of these availability problems, we have been forced to make some changes in the values of our mica trimmers. The status of our mica trimmers today is as follows:

Tek P/N	Old Value (pF)	New value (pF)
281-0044-00	80 - 480	Same
281-0118-00	8 - 90	12 - 90
281-0125-00	90 - 400	Same
281-0162-00	8 - 60	Deleted (use -0118-)
281-0180-00	18 - 115	18 - 100
281-0181-00	7 - 80	7 - 90


281-0044-00


281-0180-00


281-0118-00
281-0125-00
281-0162-00

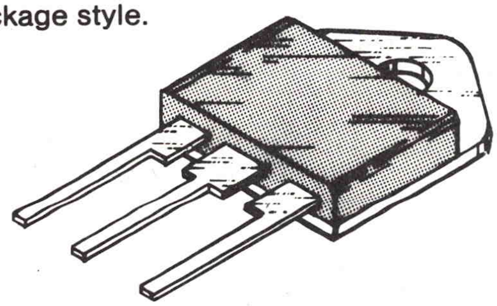

281-0181-00

All trimmers are 175V DC, and the 281-0180-00 is the most difficult for us to get (it's a side-adjust using a special right angle lead frame). A good source is expected to be approved in about two weeks, however. All other trimmers have one good source now, with one more source expected to be approved in about four weeks.

If you have any questions about these mica trimmers, please contact **Al LaValle, ext. DR-2538.**

Popular power transistor package second sourced

Motorola is now beginning to source transistors in the TO-218 plastic package, also known as "plastic TO-3." Previously, this part (and package) was available only from Texas Instruments. TI has only a moderate family of die in this package style.



The TO-218 was the first practical domestic high-power plastic package. Now that Motorola is utilizing it, we should expect a great variety of new power transistors that were formerly available only in TO-3 metal cans. This will give designers a much broader range of both electrical and mechanical design alternatives than previously available.

The first member of this new family seen at Tek, the TIP35A (P/N 151-0477-00), performed flawlessly in both electrical and reliability tests. Both second source and proprietary parts will be available for production use about the fourth quarter of 1980.

For more information, contact **Jim Williamson (78-557), ext. DR-2552.**

Fin spacing affects heat sink efficiency

Vertically oriented multi-finned heat sinks are commonly used for removing waste heat from electronic instruments. In selecting a heat sink for use in a natural convection environment, the design engineer must be aware that fin spacing can directly influence the efficiency of the heat sink.

An increase in the number of fins on a heat sink does not necessarily correspond to an increase in the cooling capabilities of the sink. In fact, a reduction in the cooling efficiency of the heat sink can result. Tek's Thermal Analysis group recently examined the effects of two fin spacings for several heat sink heights (see Figure 1).

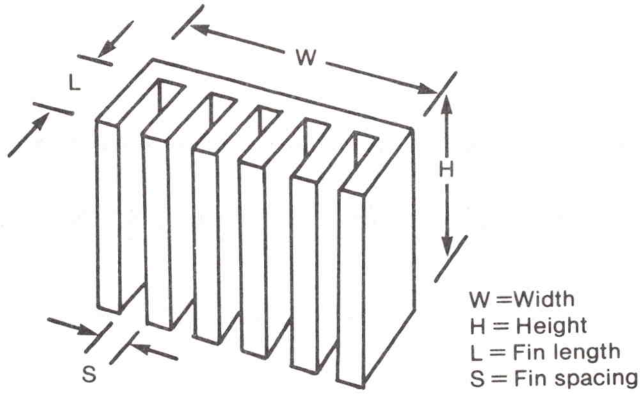


Figure 1

A reduction in fin spacing (increasing number of fins) increases the area available for heat transfer. However, this increase can be offset by a decrease in the efficiency of natural convection and radiation heat transfer. Choking of airflow through the fins can occur with closely spaced fins. Also, radiation transfer is affected by adjacent fin shielding. For a given fin length, there is an optimum fin spacing that maximizes heat transfer.

Test results

Common stock extruded heat sink material was used to calculate theoretical results and conduct the actual tests. The material was 3.8 inches wide, and had thirteen equally spaced fins. A typical fin spacing of 0.23-inch was measured. Removing every other fin increased the typical fin spacing to 0.54-inch. These two spacings were used in conjunction with a fin length of one-inch for testing.

First, theoretical thermal resistances and power dissipations were tabulated. Results showed that in 16 of the 24 cases considered, the heat sink with fin spacing of 0.54-inch would dissipate more power, i.e., would have a lower thermal resistance. For the cases considered here, the implications were obvious. If a design engineer had selected a sink with 0.23-inch spacing, s/he would have chosen a heat sink that provided no additional cooling benefit and had an increased cost and weight.

Next, limited empirical testing was conducted for verification of the theoretical results. Two six-inch samples having fin spacings of 0.23- and 0.54-inch were selected for the testing. Each sample was suspended in a protective shroud to restrict stray room air currents. Several thermocouples were situated on the heat sink to obtain a good average surface temperature. Power dissipation was by six uniformly distributed TO-220 transistor packages. Two surface conditions were considered: bare aluminum (emissivity approximately 0.1), and the sink painted black (emissivity approximately 0.8).

The tests were conducted for temperature rises of approximately 10°C, 25°C and 50°C. The results are plotted in Figures 2 and 3. Good agreement was obtained between actual and theoretical results for the conditions tested. As indicated by theory and supported by experiment, both heat sinks have very similar cooling capabilities.

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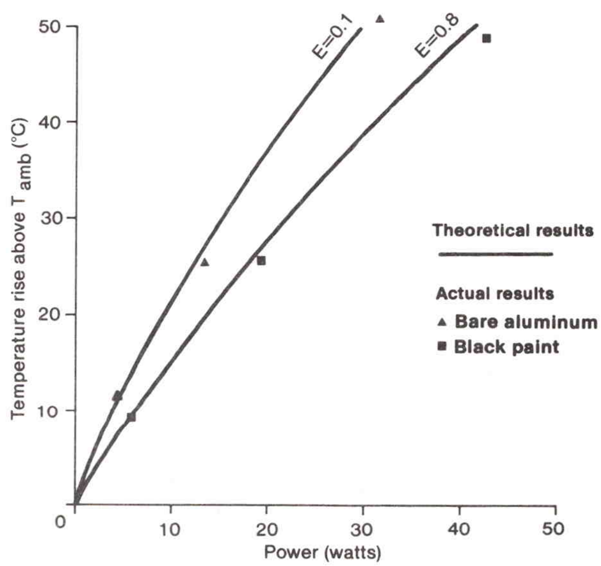


Figure 2 — Comparison of results for fin spacing 0.23 inch.

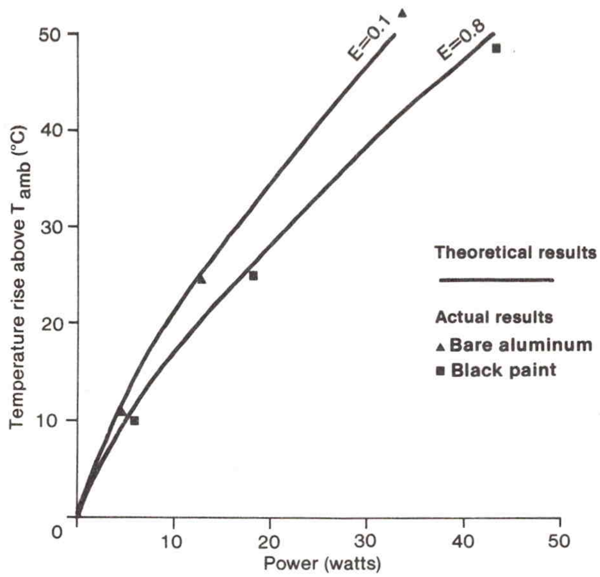


Figure 3 — Comparison of results for fin spacing 0.54 inch.

From the examples presented here, it is evident that fin spacing should be a major concern when designing or selecting a multi-finned heat sink for use in a natural convection environment.

The Thermal Analysis group is available for design support and consultation for all types of heat sink related problems. Contact **Gordon Ellison or Larry Haroun at ext. 7887, or delivery station 50-132.**

Part numbering 003- and 006- classifications

Please follow this procedure for items needing part numbers assigned under the 003-xxxx (hand tools) and 006-xxxx (operating supplies) classifications.

1. Design item.

2. Produce master title block drawing (vellum) of tool.

3. Send one copy of drawing to Frank Javorsky, 78-544.

4. If item is to be made at Tek:

a. Send one copy of drawing to Dale Betz or Jack Conner, 19-677.
b. Provide Dale or Jack with the following information:
1) Area of manufacture.
2) Stock location number.
3) Part number scheduler.
c. Dale or Jack will assign part number; base data and other areas will be notified on a need-to-know basis.
d. Add the newly assigned part number to the master drawing and send the now-completed master to Oldrich Kucera, 58-038 (Reprographics).

5. If item cannot be manufactured at Tek:

a. Provide business unit MRO buyer with three copies of print, and estimated usage.
b. Business unit buyer will locate a source of manufacture.
c. A quote date will be returned to the area requesting the item.
d. Requesting area should forward the following information to Dale Betz or Jack Conner, 19-677:
1) Copy of print.
2) Name of manufacturing company.
3) Copy of quote, including lead time.
4) Stock location number.
e. Dale or Jack will assign part number, buyer number and notify need-to-know areas.
f. Add newly assigned part number to the master drawing and send the now-complete master to Oldrich Kucera, 58-038 (Reprographics).

If you have any questions about this procedure, please call **Dale Betz (ext. 5581), Jack Conner (ext. 5277),** or **Frank Javorsky (ext. DR-2509).**

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, ext.
156-1444-xx	**TI**	**9914 GBIP chip**	**Jim Howe, W1-3583**

A bug has been discovered in the TI 9914 GPIB chip (see article on page 5). After having requested service by setting 'rsv' true, the processor will have difficulty guaranteeing that 'rsv' has been cleared internally before setting 'rsv' true again to request service a second time.

The SR function in the 9914 is implemented with a 'Master' status register which the processor writes to, and a 'Slave' register which drives the internal circuitry. Transfers of an STB from the Master to the Slave can occur only when a write to the Master has terminated AND the chip is not in SPAS.

When 'rsv' is cleared in the Master register, the processor must leave 'rsv' false until the Slave 'rsv' bit has been cleared in the Slave register.

TI has been informed about the problem.

Metallized inductor samples available

Component Engineering has samples of JFD metallized inductors. The inductors have a silver film fired permanently to a low-loss glass. They are stable and rugged.

We have not evaluated these inductors, but if there is a demand, an engineering evaluation will be undertaken. Keep in mind, however, that this type of inductor would be single sourced to JFD.

We have samples of the following model numbers available now:

Model No.	L ±5% (uh)	Q min.	at Freq. (MHz)	min. SRF (MHz)
LV5P102	.950 min. 1.10 max.	80 L min. 145 L max.	45	175
LF1P100	1.00	135	25	165
LF2W100	1.00	140	25	190
LF3P005	0.05	160	160	900
LF4W080	0.80	125	40	250

For more information, please contact **Harry Ford (78-552), ext. DR-2538.**

100192 Anyone?

A vendor of ECL components has approached Tektronix with the proposition of fabricating a device similar to the 10192, differential line driver. This new device would be offered in a 24-pin flatpack or DIP and would be fabricated with a 100K-compatible technology. Call **Dale Coleman (ext. DR-2573)** to discuss any existing or future applications for this device.

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.

analog devices

Vendor	No.	Description	When Available	P/N	Engineer to contact
Analog Devices	AD536AJH	Converter, True RMS to DC	now	156-1457-00	Matt Porter, DR-2551
Motorola	2N4401	Transistor, NPN BV_{CBO}=60V, BV_{CEO}=40V, Ic Max=500mA, fT>300MHz, 20V/20mA, TO-92 version of the 151-0302-00	Contact CE	151-0736-00	Matt Porter, DR-2551
RCA	CA3054	Amplifier, 300 MHz dual differential with current source, 14-pin DIP	now	156-1349-00	Matt Porter, DR-2551
RCA	CA3054/5	Amplifier, vendor high rel version, 300MHz dual differential with current source, 14-pin DIP	now	156-1349-01	Matt Porter, DR-2551

digital devices

Vendor	No.	Description	When Available	P/N	Engineer to contact
AMD/National	2910	Microprocessor controller, 2910, 12-bit, screened	now	156-1355-01	D. Coleman, DR-2573
Fairchild, Signetics, Motorola	10162	1 of 8 decoder, active high outputs, ECL, 16-pin DIP	now	156-1495-00	D. Coleman, DR-2573

optoelectronic and passive devices

Vendor	No.	Description	When Available	P/N	Engineer to contact
Xciton	XC5491	LED lamp, tri-state (red/green/off), 2 leads	now	150-1091-00	Louis Mahn, DR-2549
Dialight	558-0101-003	LED lamp, red with black bushing, panel mount, 6" wire leads	now	150-1093-00	Louis Mahn, DR-2549
Dialight	558-0101-002	LED lamp, red with black bushing, panel mount, 8" wire leads	now	150-1093-01	Louis Mahn, DR-2549
Beckman	—	LCD custom display, 3½-digit, 0.4" char., with AC, uncal, m, μ, n, s, V, A, K, M, Ω, p, F	fall	150-1094-00	Louis Mahn, DR-2549
Hewlett-Packard	5082-4190	LED lamp, subminiature, green, radial leads, 1.5 mcd	now	—	Louis Mahn, DR-2549
Hewlett-Packard	5082-4150	LED lamp, subminiature, yellow, radial leads	now	—	Louis Mahn, DR-2549
TRW-IRC	—	Resistor, fixed network, 1-1K+1-Ω5%	7/30	307-0765-00	Ray Powell, DR-2550
Midwest	—	Resistor, thermal, 5K-20+40%, switch at +80°C	—	307-0767-00	Ray Powell, DR-2550
Dale	—	Resistor, fixed film, 422KΩ, 0.5%, T0,½W	—	323-0445-01	Ray Powell, DR-2550
Dale	—	Resistor, fixed film, 37.5Ω, 0.1%, T9,⅛W	—	321-0793-07	Ray Powell, DR-2550
Dale	—	Resistor, fixed film, 27.7KΩ, 0.1%, T9, ⅛W	—	321-1331-07	Ray Powell, DR-2550
Dale	—	Resistor, fixed film, 7.5 KΩ, 1.0, T9, ⅛W	—	321-0373-09	Ray Powell, DR-2550
Dale	—	Resistor, fixed film, 6.98 KΩ, 1.0, T9, ⅛W	—	321-0274-09	Ray Powell, DR-2550
Midwest	—	Resistor, thermal, 10Ω±30%, peak inrush 15A, 120VAC	—	307-0768-00	Ray Powell, DR-2550
Dale	—	Resistor, fixed film, 4.02 KΩ, 0.5%, T0, ½W	—	323-0443-01	Ray Powell, DR-2550
Caddock	1776-9	Resistor network, 9.9M, 90KΩ+10KΩ, 0.25% ratio 0.1%	—	307-0769-00	Ray Powell, DR-2550

continued on page 13

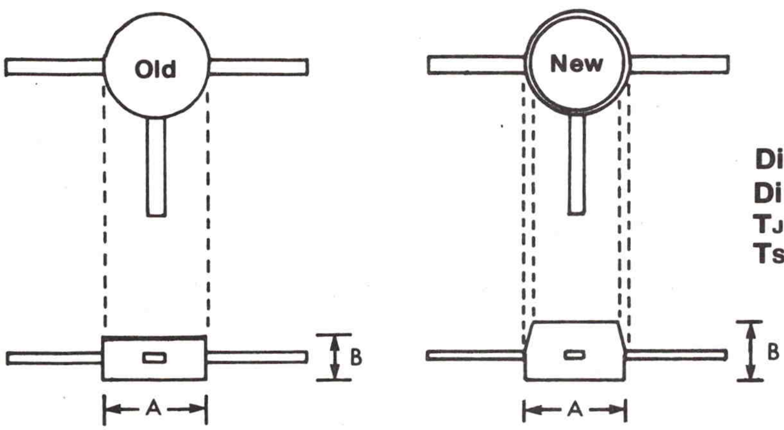
New Components, continued

Vendor	No.	Description	When Available	P/N	Engineer to contact
AVX	—	Capacitor, fixed axial, 91pF±5%, 100V, NPO	7/15	281-0872-00	Ray Powell, DR-2550
Erie	—	Capacitor, fixed axial, 2.2pF±0.5pF, 500V, NPO	7/15	281-0873-00	Ray Powell, DR-2550
Erie	—	Capacitor, fixed axial, 10pF±5%, 500V, NPO	7/15	281-0874-00	Ray Powell, DR-2550
Pyrofilm	—	Resistor, fixed film, 10MΩ, 0.25%, T9, ½W	8/1	325-0349-00	
Pres. Res. Pro.	—	Resistor, 5.9K, 0.1%, TC5, ⅛W	8/1	325-0350-00	Ray Powell, DR-2550
Pres. Res. Pro.	—	Resistor, fixed film, 5.3K, 0.1%, TC5, ⅛W	8/15	325-0351-00	Ray Powell, DR-2550
Pres. Res. Pro.	—	Resistor, fixed film, 71.5K, 0.1%, TC5, ½W	8/15	325-0352-00	Ray Powell, DR-2550
Prec. Res. Pro.	—	Resistor, fixed film, 90K, 0.1%, TC5, ⅛W	8/15	325-0353-00	Ray Powell, DR-2550
Pres. Res. Pro.	—	Resistor, fixed film, 10K, 0.1%, TC5, ¼W	8/15	325-0351-00	Ray Powell, DR-2550
Pres. Res. Pro.	—	Resistor, fixed film, 1MΩ, 0.1%, TC5, ¼W	8/15	325-0355-00	Ray Powell, DR-2550
Dale	—	Resistor, fixed film, 4.32K, T2, ¼W	7/15	322-0254-02	Ray Powell, DR-2550
TRW	X363UW	Capacitor, 0.124µF, 400VDC, metallized polypropylene	—	285-1213-00	D. Anderson, DR-2545
TRW	X363UW	Capacitor, 0.66µF, 400VDC, metallized polypropylene	—	285-1215-00	D. Anderson, DR-2545
TRW	X363UW	Capacitor, 0.35µF, 400VDC, foil and polypropylene	—	285-1214-00	D. Anderson, DR-2545
Sprague	672D	Capacitor, 10µF, 100V, aluminum electrolytic, 0.4" dia. × 0.8" H, single-ended, low ESR, 0.3A RMS ripple current	now	—	D. Anderson, DR-2545

156-0206-00 package change

NEC has changed the package on this NPN transistor from ceramic to epoxy. Along with this change, the package has been enlarged slightly and the maximum operating temperatures have been decreased, due to the different base material. The new package dimensions and operating limits are shown below.

If this change affects you adversely, please contact **Matt Porter (ext. DR-2551)**, or **Art Leacock (ext. DR-2487).**



	New (max.)	Old (max.)
Dimension – A	4.0mm	3.8mm
Dimension – B	2.5mm	2.0mm
T_J	125°C	150°C
T_{STG}	125°C	150°C

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)

Hardware Standard: Press Mount Fasteners, Standard and Rivet Type

Standard and Rivet Type Press Mount Fasteners Technical Standard, 062-4193-00, is published. You may obtain your copy by calling Technical Standards, ext. TC-241, or by sending a request to delivery station 41-260. To have the most current copy of the standard available for your use, give your payroll code along with your name and delivery station. The payroll code enables your name to be placed on a computerized name-listing for all future updatings of this standard. No charges are made for Tektronix-generated technical standards.

Volume 1, Letter-Series Standards

Many of the Tektronix Letter-Series standards are still valid and should be used as applicable. They are listed in Tektronix Standard 062-4055-04 (Directory Standards) and by subject matter in 062-4055-02. These Standards comprise what is left of the "Vol 1" Standards and will be reformatted to part-numbered standards as we can work them into our schedules.

Users should be aware that these standards are not being maintained unless some necessary change is brought to our attention. A thorough review will be made when they are reformatted. In the meantime, please call any inconsistencies to our attention.

CAD/CAM

For some time we have been receiving **Drafting and Repro Digest** which has excellent and timely information on computer-aided drafting. If you do not get this magazine, we can lend copies for one week.

ANSI Roster

A current copy of the American National Standards Institute staff telephone directory is available by calling Technical Standards. The directory lists executive and other officers, as well as telephone numbers for key personnel. It would be of help to anyone wishing to contact ANSI personnel directly for advice, guidance or information. ANSI's address is:

American National Standards Institute
1430 Broadway
New York, NY 10018

Attention all holders of ANSI/IEEE STD 488-1978

Please check your current copy (on the page entitled **Note Relation to IEC Standards).** Make sure it has these words below the note:

"Corrected Edition June 22, 1979"

If your copy does not have this statement, it is not to be used. New copies can be ordered by calling Technical Standards.

New standards available

NEMA SP/NO.PR 3-1980	Guide to **Pin** and **Sleeve** Plugs, Receptacles and **Connectors**
DOD-STD-863B	Revision: Preparation of Wiring Data and System Schematic Diagrams
MIL-R-55082A	Relay Assembly Re-170/M
FED-Std-368A	Quality Control System Requirements

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Technical Standards, continued

IPC-T-50A	Industry Standard, Terms and Definitions
UL 62	**Flexible Cord and Fixture Wire.** New and revised pages for the twelfth edition of UL 62
MIL-N-87144	**Networks,** Fixed Film Resistors and Ceramic Capacitors — for incorporation into electronic circuits
MIL-D-51456	**Detector Cell,** Chemical Agent, Ultrasonically Welded
ANSI B1.13M	**Metric Screw Thread** — M Profile
MIL-R-83407	Amendment 1. General Specification for **Relays, Reed** (Mercury Wetted)
MIL-S-22885/7 7B	Amendment 1. **Illuminated, Pushbutton Switches,** 4-Lamp, 0.75 Square, 7.5 Amperes, Electromagnetic Interference Shielded
MIL-STD-1562B	Superseding MIL-STD-1562A, Lists of Standard Microcircuits
EIA-RS-186-9E	Standard Test Methods for Passive Electronic **Component Parts.** Method 9: Solderability
MIL-C-17E	Supplement 1. General Specification for Flexible and Semirigid, Radio Frequency, **Cables**
UL 1418	**Revision pages for pages 9, 10 dated November 4, 1977.** Implosion-Protected Cathode-Ray Tubes for Television-Type Appliances
MIL-C-3965F	Supersedes MIL-C-3965E. General Specification for **Capacitors,** Fixed, Electrolytic (Nonsolid Electrolyte), Tantalum
MIL-C-39012B	Supplement 1B. General Specification for **Connectors,** Coaxial, Radiofrequency
IPC	The IPC Technical Review, January issue, featuring Part One of a Two-Part Technical Paper, **Condensation Soldering Technology**
NEMA SP FB-10-1973	General Requirements for Plugs, Receptacles and Connectors of the Pin and Sleeve Type. Please delete this publication from your files.
DOD-B-24507B(SH)	Amendment 1. Military Specification **Battery Cells,** Storage, Silver-Zinc Alkaline Type (For NR-1) Metric
NBS PB-294 845	Guide to **Technical Services** and **Information Sources** for ADP Managers and Users
NBS PB-293 487	**CMOS/SOS Test Patterns** for Process Evaluation and Control: Annual Report. March 1 to November 1, 1978
NBS Technical Note 958	Four versatile **MIDAS** Compatible **Modules**
ANSI/NMA MS4-1972 (R1978)	National Standard **Flowchart Symbols** and Their Usage in Micrographics
NMA MS 301-1979	Micrographics Systems **Flowcharting Template**
MIL-W-5086C	**Copper or Copper Alloy Wire,** Electric, Polyvinyl Chloride Insulated. **Amendment 1**

The following **Electromagnetic Waves Books** are published by Peter Peregrinus Ltd. on behalf of "The Institution of Electrical Engineers" (U.K.), and can now be ordered by calling Technical Standards.

Reflector Analysis and Design P. Wood ISBN 090 604821 4, 256pp, 107 diagrams, 1980	$35.00
Waveguide Tapers, Transitions & Couplers F. Sporleder & H. Unger ISBN 090 604816 8, 320pp, 138 diagrams, 1979	$35.00
E.L.F. Communication Antennas M. Burrows ISBN 090 605871 9, 343pp, 76 diagrams, 1978	$31.00
Radio Direction Finding and the Resolution of Multicomponent Wave-Fields ISBN 090 60480 0, 253pp, 71 diagrams, 1978	$35.00
Microwave Homodyne Systems R. King ISBN 090 122352 2, 336pp, 1977	$36.00

For more information on the publications listed above, please call ext. TC-241, or write to 41-260.

Memory Selection Guide
Flexible Disks

This selection guide, prepared by Memory & I/O Component Engineering, is a first step toward assembling and organizing the Tek documentation for flexible disks which have been part-numbered. The information presented here was gathered from the existing documentation (very little exists for these parts) and various Tek buyers' notes. Because none of the flexible disks shown in the guide were evaluated by CE, we are not necessarily recommending their use in a new design.

Anyone wishing further information on magnetic media may contact **Dick Green, Memory and I/O Component Engineering, ext. DR-2541.**

	Tek Part Number	Hard/Soft Sectors	Sectors/Track	Bytes/Sector	Tracks/Side	Unformatted Capacity (KBYTES)	Formatted Capacity (KBYTES)	Vendor	Vendor's P/N
Single Side/Single Density	119-0666-xx	Hard	32	128	64	312.5	262.144	Memorex	FD/IV
								Verbatim	FD65-1144
	119-0847-xx	Soft	26	128	77	401	246.272	Verbatim	FD34-1000
								DEC	RX01K-10
	119-0848-xx	Hard	32	128	77	401	315.392	Verbatim	FD32-3014
	119-0967-xx	Soft	26	128	77	401	246.272	IBM	2305830
Single Side/Double Density	119-1011-xx	Hard	32	256	77	401	630.784	Shugart	SA103
								Verbatim	FD32-8000
	119-1376-xx	Soft	Not Pre-formatted		77	802	—	Dysan	3740-1D
Double Side/Double Density	119-1182-xx	Soft	Not Pre-formatted		77	1604	—	Dysan	3740/2D
								Verbatim	DD34-4001
Special Purpose	119-0896-00	Dysan 240S Alignment Diskette							
	119-0953-00	Shugart SA120 Alignment Diskette							
	119-0993-00	Shugart SA120 Alignment Diskette							

component news

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To submit an article, contact Jacquie on ext. 6867.
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