COMPONENT NEWS
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Hall effect switch prices drop

With costs continuing to drop, solid state Hall effect sensors are now providing an attractive alternative to the more conventional switching methods.

In addition to becoming cost competitive, Hall effect switching has the advantage of long life, speed of operation and no contact bounce, resulting in a reliable logic level interface. There are no contacts to suffer from contamination or damage in solder flow and wash operations.

Hall effect switching is not a new concept. Tek has manufactured linear Hall effect probes for several years, most recently the P6302 current probe for the AM503. Now, with lower prices and increasing options, Hall effect devices are also likely to be designed in digital and pulse applications.

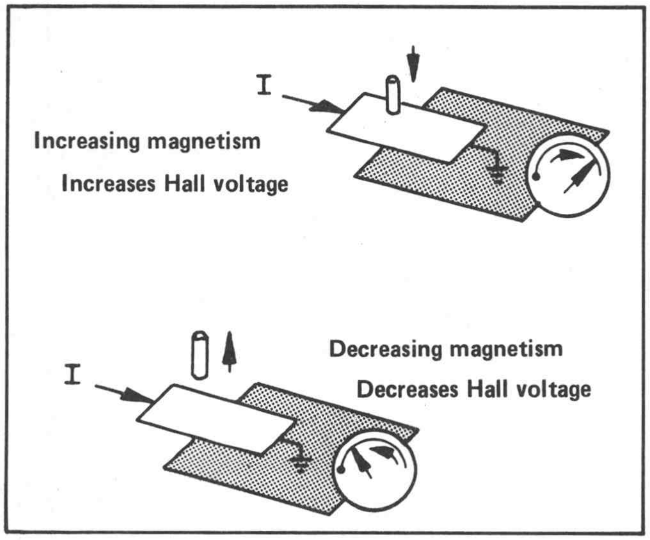

Figure 1: *The Hall effect principle*

theory of operation

The Hall effect was discovered in 1879 when Edward H. Hall found that voltage could be generated across opposite edges of a current-carrying conductor when placed in a magnetic field. The voltage is proportional to the flux density perpendicular to the conductor and to the current through the conductor.

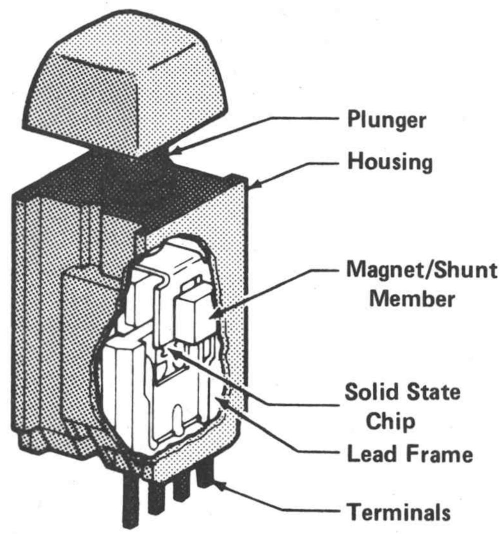

Figure 2 — *Hall effect keyboard switch. There are no internal moving parts to wear out or limit the speed of operation. Up to 30k operations per second have been achieved, with no bounce or timing problems.*

In most Hall effect devices, the current through the element is held constant, so the Hall voltage is proportional to the magnetic field (see Fig. 1). The magnetic induction (or flux density) can be increased or decreased by varying the distance between a permanent magnet and the conductor.

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The output signal rise and fall time are under 10μsec and are not affected by the rate of change of operating flux. Because the Hall effect is a DC phenomenon, the magnet doesn't have to be moving; *as long as a magnetic field is present, a voltage is generated.*

Hall effect devices can be produced on a single conditioning circuitry, transfer function circuitry and the logic output interfacing.

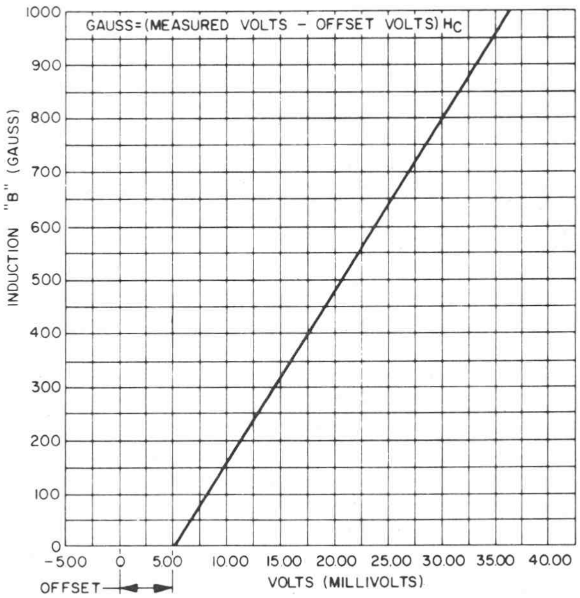

Figure 3: *Hall element curve*

The **Hall element** senses the presence of a magnetic field and provides a linear electrical output proportional to the flux density, as shown in Figure 3. This data was measured at 5 ±0.5 VDC and at 24 ±2°C (operation at other voltages or temperatures will produce different readings).

The offset voltage (shown as 5 mV) is determined by the placement of connections to the Hall element and is controlled by the manufacturer. Offset voltages typically range from 0 to 10 mV.

The Hall element requires some sort of **signal conditioning** to provide good interfacing. This includes improving the linearity, temperature and voltage compensation, signal amplification, voltage regulation, etc.

The output of the Hall element, as a function of magnetic flux, is linear and must be modified to perform a switching function. The **transfer function** circuitry provides either a digital, pulse or amplified linear output with either standard, sensitive or bipolar magnetics.

Various **output interface** options are available with Hall effect sensors and are separated into two major types: current sourcing and current striking, with either a normally high or normally low quiescent condition. Also, the outputs may be differential (one increasing, other decreasing) or isolated.

transfer functions

Linear output Hall effect sensors have been the most common, basically functioning as amplifiers of magnetic variations with an electrical output. In general, the linearity of magnetic induction to output voltage is very good for changes in induction in the range of -500 to +500 gauss, but they are still very sensitive to changes in temperature.

Pulse output sensors provide a normally high output voltage pulse when actuated by a magnetic field. When sufficient gauss is applied, the output goes to a low state, then automatically returns to a high state after a built-in time delay. The shape and duration of the pulse are determined by a trigger and pulse forming network.

An advantage of pulse type sensors is that the constant, short-duration signal is independent of actuation time. Also, the occurance of each pulse is the same as the repetition rate or time between actuations.

Digital output Hall effect devices have a step function generator so the output exists only in two discrete levels. The step function has a built-in hysteresis to avoid oscillations due to small variations of the actuating signal at the transistion point.

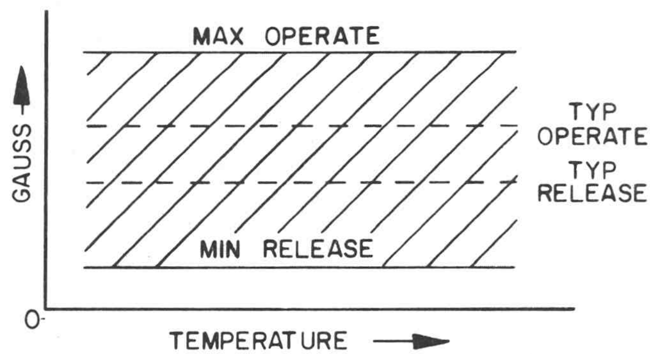

Figure 4: *Typical standard magnetic characteristics*

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magnetic characteristics

Four different types of magnetic characteristics can be designed into digital Hall effect sensors: standard, sensitive, bipolar and latching.

The **standard** magnetic characteristics of a Hall effect sensor are shown in Figure 4. The device is operated and released with a single magnetic pole and has a medium differential for good noise margins.

Devices that are operated and released at a lower gauss level have **sensitive** magnetic characteristics, with a smaller differential than the standard types. See Figure 5. This permits use of a smaller or weaker magnetic field with a possible sacrifice in noise immunity.

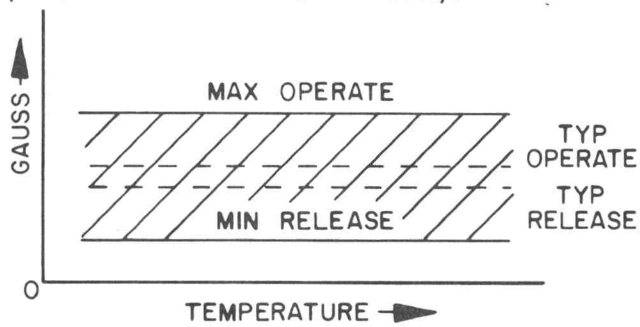

Figure 5: *Typical sensitive magnetic characteristics*

Bipolar devices use a Hall element that is designed to operate with a ring magnet or a magnetic actuator that provides reversing polarities of magnetic field. See Figure 6.

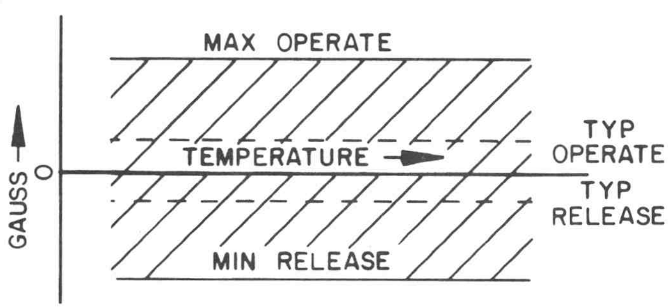

Figure 6: *Typical bipolar magnetic characteristics*

The operate and release points *may be both positive or both negative* so latching is not guaranteed. Bipolar devices are biased for adequate noise margins and to insure operating and releasing when the magnetic field isn't present.

Latching type devices utilize a south pole to operate it (output will remain activated after the magnetic field is removed) and a north pole to release it. See Figure 7. These devices require a large differential with maximum and minimum operate and release points.

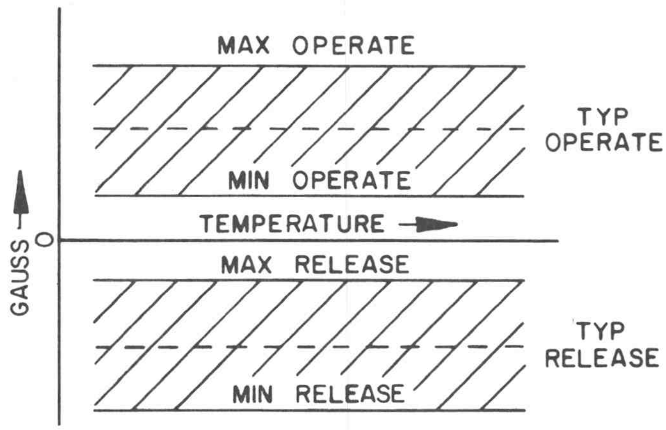

Figure 7: *Typical latching magnetic characteristics*

application considerations and guidelines

The application of magnetically operated Hall effect sensors is not too different from that of most other electromechanical devices (e.g. mounting, electrical connections, etc). In addition, you'll probably have to provide a magnet that will be moved or rotated to change the magnitude and/or direction of magnetic flux so as to operate and release the sensing element.

In most applications, the magnetic requirements of a particular Hall effect switch will have to be converted into magnetic material, size, configuration and position. Given the operate and release gauss levels, you'll have to determine if the magnet you've selected will actuate and release all devices in your application considering temperature, voltage, magnetic positioning, manufacturing tolerances, etc.

MICRO SWITCH recommends the following steps when considering Hall effect sensors for a specific application:

1. What type of sensor is needed?
   a. measure position or movement
   b. measure current

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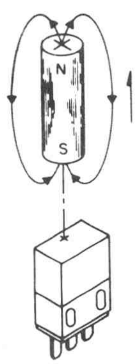
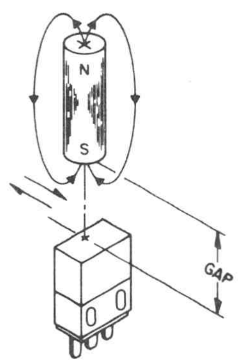
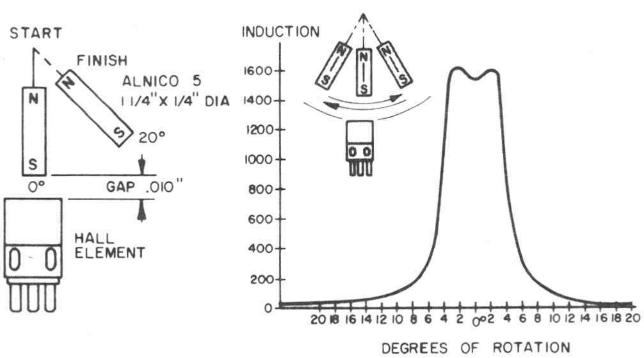
2. What transfer function type is required?
   a. linear
   b. pulse
   c. digital
3. How will you actuate the sensor?
   a. electromagnet—input current creates the magnetic force
   b. permanent magnet
      —active: magnet or magnetic target moves
      —passive: not a part of the actuator (for example, a vane type or proximity sensor)
4. If an active permanent magnet is selected, what mode of operation is best?



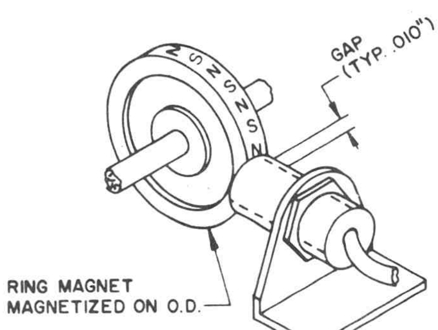
a. head-on actuation



b. slide-by operation



c. pendulum operation (combination of head-on and slide-by modes)



d. rotary operation

5. For permanent magnet actuation, these items must also be considered:
   a. material-how different magnetic materials affect the operate and release points
   b. tolerances
   c. magnetic properties—e.g. residual induction
   d. configuration—bar, horseshoe, multipole, etc.
   e. size
   f. magnetization
   g. flux concentrators and pole pieces
   h. cost (becoming available at very low costs)

availability and applications

With their high reliability, long life (reportedly up to 12 billion operations) and decreasing costs, the majority of Hall effect sensors are now found in keyboards. The only mechanism to wear out is the spring.

Hall effect devices are available in discrete plastic packages, keyboard and panel switches and also as vane-type, proximity, and current sensors. These devices are summarized in the table on page 5.

Of particular interest are the small discrete packages such as the TI TL170C in a TO-226AA package (available now), and the TL171C in a "tie tac" package (available in a year). These devices can be used at Tek to build up our own keyboards. Discrete devices are also suited for digital isolation applications.

Front panel switching or larger, more expensive instruments can be accomplished using the AML series of panel switches from MICRO SWITCH. These devices have high reliability as well as excellent aesthetics and feel.

Precision switches can be used for position sensing in equipment such as hard copy units, plotters, etc. These switches, like all Hall effect devices interface reliably with digital logic.

for more information

For additional details, contact Joe Joncas in Component Engineering, ext. 6365.

Illustrations and portions of this article are reprinted from the MICROSWITCH Handbook **for Applying Solid State Hall Effect Sensors.** Copies of this handbook are available from Technical Communications, 58-299, ext. 6867.

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Hall effect devices

Type	Vendor(s)	Transfer function			Cost/1k	Comments
		linear	pulse	digital		
Discrete	MICRO SWITCH Sprague Texas Instruments Panasonic	√	√	√ √ √ √	$1–2 50–70¢ 34–39¢ 60–69¢	several package types 3 package styles TO-226AA package one package style
Panel switches	MICRO SWITCH			√	$3–8	AML series
Keyboard switches	MICRO SWITCH		√	√	$1.25–2	scan output also available
Keyboards	MICRO SWITCH	not applicable			$60–53 key $80–88 key	washable, reliable
Precision switches	Omron MICRO SWITCH			√ √	$4–5 $2.25–2.75	
Enclosed proximity switches	MICRO SWITCH			√	$3.50–6.50	12 types available
Vane type switches	MICRO SWITCH			√	$1.50–3.50	around 10 types
Current sensors	MICRO SWITCH			√	$8	six types

AVAILABILITY REPORT: PLASTIC VS. METAL CAN TRANSISTORS

In response to the "Reliability Report", page 15 of **Component News**, issue number 256. It should be mentioned for the benefit of those users who might be considering the conversion from plastic to metal can transistors that product availability of metal can transistors is limited. Each year there are fewer and fewer semiconductor manufacturers who are actively soliciting business on metal can transistors.

In addition to the availability problem, costs of the metal can devices are significantly higher than the plastic version, i.e. 151-0190-00 at $.06 to $.07 while the 151-0190-06 (metal can) is currently priced at $.28. It should also be noted that while the cost of metal can discretes is escalating 10-20% each year, the suppliers are constantly requesting that we convert to plastic devices wherever possible.

In conclusion, for long term production support the increased use of metal can transistors should be undertaken discreetly.

Ken Stucki
Purchasing

Personnel announcements

Don Gladden recently joined the Analog Component Engineering group. Don will be responsible for evaluating D/A converters and linear ICs. Contact him at 58-299, ext. 6700.

Jack George, manager
Analog Component Engineering

Gene Single, Component Engineering, will now be involved in evaluating EMI filters, attenuators and terminations. This is in addition to his responsibility for evaluating potentiometers and other variable resistors.

Bob Chen, manager
Optoelectronic and Passive Component Engineering

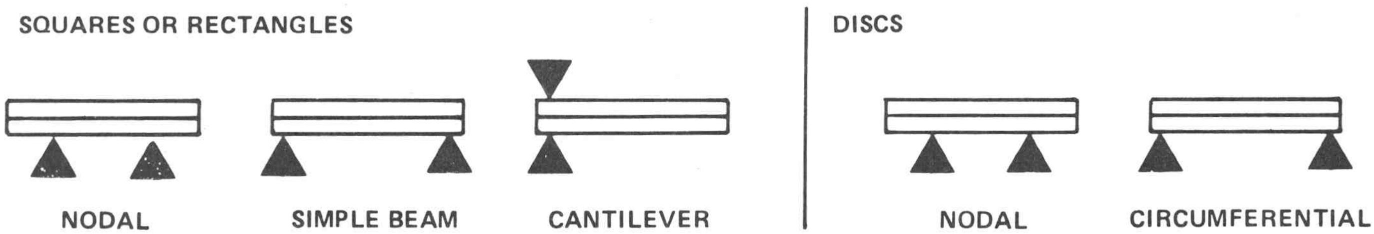
Update on audio transducers

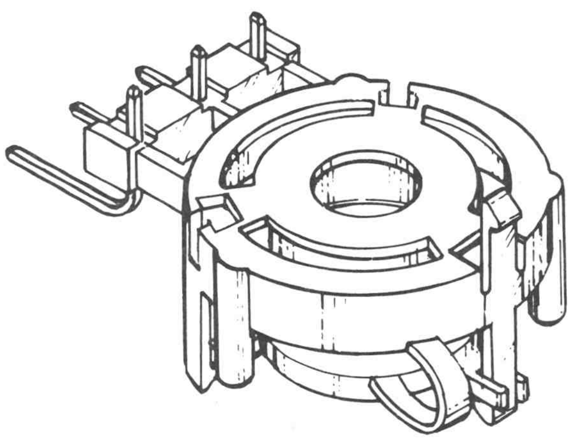
We noted recently that audio transducers are under evaluation by Component Engineering. Because a number of people have made inquiries to CE about the transducers, we are running another article describing more application information.

Audio transducers (also referred to as "benders") are small discs of special piezo-ceramic material that change diameter when an electrical signal is applied across the surface. It should be pointed out, though, that they will not produce any sound if DC voltage is applied. External circuitry, in the form of an oscillator that will produce AC voltage, is needed to drive the transducer.

As the amount of voltage applied to this oscillator circuit is varied, so too will the amount of output vary. Also, the frequency of resonance (and impedance) will vary with the method of mounting. Some of these mounting methods are pictured below, along with an illustration of one manufacturer's special mounting bracket.

TYPICAL MOUNTING TECHNIQUES





Some other features of audio transducers include:

- □ Can be used as a voltage generator (below resonance).
- □ Depending on the particular device used, an output of 85 dB or more (at a distance of 15 feet) can be achieved.
- □ Some benders are designed to operate in the 1 - 4 kHz range, the maximum attention-getting frequency for human ears. This makes them particularly suitable for use in audio alarms installed in emergency alert devices.
- □ One device (Linden Laboratories' 70067), when driven with 5 - 9 volts, can produce sounds ranging from 500 to 12,000 cycles/second. This provides the design engineer with unlimited sound quality output by simply altering the drive circuits.
- □ According to the manufacturer, the 70067 lends itself to a rigid edge mount, providing a low-cost mounting method.
- □ Another advantage to some of these devices is their fast rise and decay time, which can produce a variety of sounds by pulsing or sweeping.
- □ In small quantities, the cost of these devices runs less than one dollar each. In very large quantities, the cost can be as low as 33 cents per part.

For more information, please contact Byron Witt, ext. 5417.

Special Announcement

As of press time, National Semiconductor just announced that they will cease production of their 5320 TV sync generator (Tek P/N 156-0946-00). There is no second source for this device.

The recommended replacement is the 5321 sync generator, which is compatible with the 5320 except for pin 7. On the 5320, the pin is left floating, while on the 5321 it must be tied high (V_{SS}) to function the same as the 5320. The specs on the 156-0946-00 will be changed to reflect the 5321.

Please contact Bill Pfeifer (ext. 6303) for more information.

CMOS, JFET static sensitivity tests

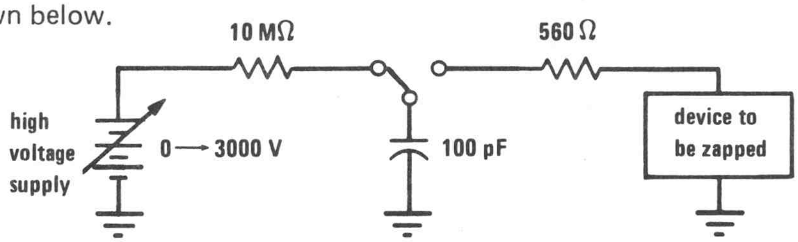
Reliability testing on the 4051 CMOS 8-channel analog multiplier (Tek P/N 156-0513-00) has been completed by Component Reliability Engineering (CRE).

Forty-six samples from Motorola were tested at 150°C ambient, with supply voltages set at ±9 volts. All of the remaining pins were grounded. Parts were checked on an S3260 system, with off-channel leakage currents data-logged. Life test results follow.

Number of failures at				
0 hours	**16 hours**	**36 hours**	**96 hours**	**336 hours**
2	0	3	0	0

In addition, a static sensitivity study is being conducted on National JFET and Motorola CMOS analog switches. Twenty samples from each of the following were evaluated: JFET—LF13333 (no Tek P/N), CMOS—4051 (P/N 156-0513-00) and 4066 (P/N 156-0644-00).

The parts were statically "zapped" by a charged-up 100pF capacitor. The voltage of the capacitor was increased in 200 volt increments until the parts showed leakage current in excess of 100nA. The discharge circuit is shown below.



Note: See the table of commonly encountered electrostatic potentials on the following page.

In the LF13333 and the 4066, one of the terminals of the switch was zapped. Leakage was measured between the two terminals with the control in the "off" state. For the 4051, two conditions were tested: (1) One of the eight channel I/O pins was zapped, and leakage was measured between the input and output with the proper address select and inhibit on; (2) One of the address lines was zapped, and leakage was measured between that address line and ground.

Results of these tests show that for the LF13333, with positive and negative voltages up to 3000 volts, all 20 parts showed no leakage current. The 4051 parts exhibited the following characteristics: Condition 1—for positive and negative voltage up to 3000 volts, all 20 parts showed a negligible amount of leakage (one part showed a 40nA leakage at 7.5V after a 3000V zap). Condition 2—for negative voltages up to 3000 volts, all 20 parts showed no leakage current. For positive voltages, the results are shown below.

Number of failures* after a zap of					
0-600V	**800V**	**1000-1600V**	**1800V**	**2000V**	**2200V**
0	1	0	3	7	5

In the 4066 devices, 20 samples were zapped by positive voltages and another 20 by negative voltages. Results were:

	Number of failures* after a zap of						
positive	**0-800V**	**1000V**	**1300V**	**1500V**			
	0	1	0	9			
negative	**0-1500V**	**1700V**	**2100V**	**2300V**	**2500V**	**2700V**	**2900V**
	0	1	1	3	2	1	3

*All failures were due to an abnormal increase in supply current.

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Considering the results of these tests, Component Reliability Engineering recommends a 48-hour burn-in and 100% electrical test for CMOS analog switches. Also, the 4051 and 4066 analog switches should be handled in as static-free an environment as possible. Compared to the CMOS counterparts, static discharge has little or no effect on JFET switches.

CRE plans to conduct reliability tests on JFET switches as soon as automated test programs are available. In addition, one more static sensitivity study will be performed on the TL191 as soon as the parts are available.

For more details on these activities, contact Steve Hui, ext. 6511.

Common static electricity conditions

In general, damage resulting from static discharges is due either to some form of junction burnout or a rupture of a thin oxide layer (as in MOS devices). This table shows common static electricity conditions measured by Western Electric Company in a room where the relative humidity varied from 15 to 35% during the observation period. Also shown, for reference, is the amount of energy available under each condition, assuming body capacitance of 60pF (energy = $1/2CV^2$).

	Median reading volts/joules	Highest reading volts/joules
Person walking across carpet	$12{,}000/4 \times 10^{-4}$	$39{,}000/5 \times 10^{-3}$
Person walking across tile floor	$4{,}000/5 \times 10^{-5}$	$13{,}000/5 \times 10^{-4}$
Person working at bench	$300/2 \times 10^{-9}$	$3{,}000/3 \times 10^{-5}$
16 lead DIPs in plastic box	$3{,}500/4 \times 10^{-5}$	$12{,}000/4 \times 10^{-4}$
16 lead DIPs in plastic shipping tube	$500/2 \times 10^{-9}$	$3{,}000/3 \times 10^{-5}$

741 op amp specification revised

The 741 op amp (156-0067-00 and -02) specifications have been changed to more closely match our needs and manufacturer's capabilities and to obtain a less expensive device.

The J revision of the 156-0067-00 spec and the D revision of the -02 spec incorporate the following changes:

1. Deleted noise spec (expensive to measure, especially if required for every device; poor correlation of measurements).

2. Deleted offset adjustment range (should not affect any known applications; caused low yield for some manufacturers).

3. Deleted minimum bias current spec (15 nA minimum current spec resulted in low yield, low gain if pin open).

4. Relaxed short circuit current to ground spec to 40 mA maximum at 25°C and to 45 mA over the temperature range. (Devices with good, high output current, had problems meeting this spec.)

5. Relaxed short circuit current to either supply to 45 mA maximum at 25°C and to 50 mA over the temperature range. (Devices with good, high output current, had problems meeting this spec.)

6. On rating, added "output short circuit duration...indefinite."

7. Changed minimum output current over temperature from ±10 mA to ±9 mA (discrepancy due to ±10 mA at 25°C, output current with increasing temperature decreases).

8. Changed V_O from ±12V to ±10V on voltage gain condition (discrepancy due to minimum output swing specified at ±11V. The requirement for 94dB gain is still higher than standard).

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vendor status

NEC has just been qualified for the 741 op amp and they look to be an excellent source. Their quality and reliability is very good, and the price is low (approximately 20¢). One fault, though, is that the NEC device has a fairly nonlinear output with a 2k load, which results in low gain. The qualifying (Q) order met the gain specification well.

RCA also has good quality, reliable parts. Their gold chip devices have exhibited a failure mode, which will be discussed in a future article if it appears to be a problem.

Signetics is a good source but they have been disqualified for the -00 part because of application problems and failure to meet short circuit current and offset adjust specifications. Their devices now meet the J specification, but we are still working with them on the application problem. They've agreed to change resistor values on the 741 chip to take care of the too high gain bandwidth problem.

Texas Instruments has fixed their output latch-up problem and they will ship another Q order after they improve the reliability.

Fairchild has substantially improved their 741 device and it looks very good. Their devices are being tried in the plant now, but even if qualified, Fairchild does not appear to be a good source due to delivery problems on other lines.

Other vendors, such as Silicon General (humidity problem) and Intersil, have been evaluated and may be qualified in the future.

156-0067-00 suffix numbers

In the past, it was thought to be less expensive to select a 741 with differing spec values than to have a general specification covering all applications. These special part numbers (e.g. -03, -04, etc.) created yield, quantity, inventory, inspection and purchasing problems.

Now, improved processes and design have yielded other devices with better performance for the same (or lower) cost. It is no longer feasible to use the selected parts. See recommendations below.

For more information, contact John Hereford in Analog Component Engineering, (58-299), ext. 6700.

Tektronix 156-0067-XX 741 op amp specifications

Recommended for new design 156-0067-xx

-00	General 741 op amp specification
-01	100% tested -00 part
-12	Ceramic package only. Lot sampled for reliability (life test). 100% electrically tested. Standard manufacturer's electrical specification.

Not recommended for new design 156-0067-xx

-02	Selected for offset current = 20 nA, bias current = 100 nA. Able to get better part (e.g. BiFET op amps) for lower cost
-03	National only. Poor delivery, quality (high noise) and reliability. Was set up to supply -02, but now other manufacturers' parts perform better.
-04	Selected for >90 dB common mode rejection and >106 dB open loop gain
-05	Selected for <1 mV offset voltage, <20 nA offset current
-06	Selected for ±20V breakdown. Ceramic package only. Poor lifetime when operated at high supply voltage
-07	Deleted — was a checked -09 part
-08	Selected for 6μV/°C drift
-09	Fairchild only — they did not have thermal intermittent problems at the time. No longer used
-10	Burned-in and tested -00 for use in T900 (will be using -12 part)
-11	RCA only. Set up by TV Products to compare reliability of plastic gold chip to the -12 part
-13	100% burn-in and tested -12 for several TV Products.

Alternative tubular capacitor line sought

Our only supplier of tubular trimmer capacitors has discontinued production of certain styles within the product line.

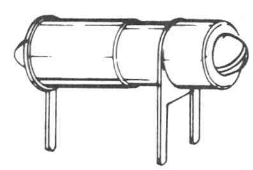
Initially, we were notified they would no longer be able to manufacture our part, Tek P/N 281-0216-00. We quickly found another vendor who could supply the part, but we had to accept a lower voltage rating and change some other parameters on our specifications to allow their use.

Now, the original supplier has stopped producing our part, Tek P/N 281-0215-00 as well. We are having a very difficult time finding a new supplier for this item. While we have performed tests on two sample quantities of a possible replacement, so far the results have been unacceptable.

Manufacturing Engineering, along with Component Engineering, is now studying the usage of the 281-0215-00, and searching for a replacement.

As a precautionary measure, until we can establish reliable sources or recommend alternative components for existing designs, I am categorizing the following part numbers **"Not Recommended for New Design."**

281-0213-00	0.8 - 3.8pF	400V
281-0214-00	0.5 - 3pF	400V
281-0215-00	1.2 - 10.2pF	400V
281-0216-00	0.8 - 6.8pF	*250V
281-0217-00	0.5 - 3.5pF	400V
281-0220-00	1.0 - 5.5pF	400V
281-0222-00	1.0 - 6.5pF	400V



*originally 400V

For further information, please contact Merle Hendricks, ext. 5415.

'Switchmode' plastic power transistors P/N'd

Over the past two years, Motorola has introduced its "Switchmode" series of plastic power transistors. Switchmode devices are designed for high-voltage, high speed power switching inductive circuits, where collector current fall time is critical.

These parts are particularly suited for 115 and 220 volt AC applications such as switching regulators, inverter/converters, motor controls, solenoid/relay drivers and deflection circuits.

The construction of these transistors is a modified double-diffused, multiple epitaxial mesa collector process. This technique simulates triple-diffused mesa very closely in terms of sustaining voltage and SOA (safe operating area). All are NPN devices, with $V_{CEO(sus)}$ ratings of 400 volts.

The following devices have been Tek part-numbered:

Tek P/N	Motorola P/N	I_C (max.)	P_D (25°C case)	Package
151-0634-00	MJE 13003	1.5A	40W	TO-126
151-0678-00	MJE 13005	4.0A	75W	TO-220
151-0632-00	MJE 13007	8.0A	80W	TO-220
151-0679-00	MJE 13009	12.0A	100W	TO-220

For more information on these transistors, contact Jim Williamson (58-299), ext. 5345.

Fastfit BNC connectors introduced

Cambridge Products Corporation recently introduced a new line of "fastfit" BNC connectors.

The manufacturer claims these parts require no contact soldering or crimping, and can be assembled easier and faster than standard connectors. This might make them suitable for field/service and bench repair applications.

According to the manufacturer, the heart of the "fastfit" series is a self-energizing center contact, pre-assembled in the body, which provides a positive mating of the center conductor and the contact.

The cable attachment is achieved by a tapered and threaded back-end opening, which makes it easy to twist the unit onto the cable braid and jacket. Using these connectors helps eliminate loose clamp nuts, insulators, and the need for several tools required to install standard BNCs.

Some of the electrical characteristics include: nominally 50 or 75 ohm impedance; peak voltage rating 500 volts RMS; insertion loss less than 0.1 dB at 2 GHz.

For more information, please contact Larry Berry, ext. 5417.

Hazardous conductive coating

We've been advised that a conductive coating or paint called "Z-COT" manufactured by Metex is hazardous to human health. This product is not currently purchased by Tek and **should not be considered** for use at anytime.

For more details, call Herb Zajac or Pat Adamosky at ext. 7887.

CMOS-bipolar devices proposed

Teledyne Semiconductor is planning to develop five new devices provided that there is an interest in them. They use a combination CMOS-bipolar technology. They are intended to hook on to a microprocessor bus and drive high voltage (30V) and/or high current loads.

The 9502 is an 8-bit serial-in, parallel-out shift register with latch. The output currents (sink and source) are programmable from 0 to 18 mA to drive LEDs directly. Input currents are 10 μA maximum.

The 9503/9504 is an octal latch (9503), or D-type flip-flop (9504) with Schmitt-trigger inputs intended to interface from the outside world to the microprocessor bus.

The 95373/95374 is an octal latch (95373), or D-type flip-flop (95374) intended to drive loads of up to 50 mA at up to 30V. Loading on the bus inputs is 10 μA maximum.

For more detailed data sheets, contact Bill Pfeifer at 58-299 (ext. 6303).

NE5539 monolithic op amp

Signetics will be producing a very fast, wide bandwidth, monolithic operational amplifier initially developed by Philips. Signetics' number will be NE5539.

The op amp has a gain bandwidth product of 1.2 GHz at a gain of 7 and a 800V/μsec slew rate with a gain of 2.

The device's basic circuit is an uncompensated amplifier with emitter follower input and output, but closed loop gain down to 17dB is allowed without frequency compensation. With ±8V supplies, the NE5539 swings to +2.8V and -2.6V and can output 40mA.

The NE5539 will be in production in August and cost under $5. I have some evaluation samples that can be looked at now.

John Hereford, ext. 6700
Component Engineering

New failure report format

We recently added the capability for displaying Time-to-Failure on all warranty field failures. This plot, by instrument, is in two-week increments out to 60 weeks.

We anticipate the most requested options will be:

1. All types of failures.
2. Workmanship (component only).
3. Specific generic part number (151, etc.).
4. Individual part number (156-0049-00).

Call Rich Wood or Don Allen on ext. 5794 with requests for data.

Clair Gruver, manager
Reliability Information group (58-176)

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)*

new items that can be ordered through Technical Standards

76 ANSI/IEEE Y32E (1978) Electrical and Electronics Graphic Symbols and Reference Designations ($19.95). The five standards contained in this hardbound volume are:

- Graphic Symbols for Electrical and Electronics Diagrams IEEE Std 315-1975, CSA Z99-1975, ANSI Y32.2-1975
- Graphic Symbols for Electrical Wiring and Layout Diagrams Used in Architecture and Building Construction ANSI Y32.9-1972
- Graphic Symbols for Logic Diagrams (two-state devices) IEEE 91-1973, ANSI Y32.14-1973
- Reference Designations for Electrical and Electronics Parts and Equipments IEEE Std 200-1975, ANSI Y32.16-1975
- Graphic Symbols for Grid and Mapping Diagrams Used in Cable Television Systems IEEE Std 623-1976, Ansi Y32.21-1976

IEEE 518-1977 Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources ($10.00)

new and revised standards that may be ordered from Technical Standards:

ANSI X89.1-1969 Safety Requirements for Industrial Head Protection ($3.75)

IEC 512-2 Electromechanical components for electronic equipment; basic testing procedures and measuring methods, Part 2: general examination, electrical continuity and contact resistance tests, insulation tests and voltage stress tests (1976)

IEC 512.3 (1976) Electromechanical Components for Electronic Equipment; Basic Testing Procedures and Measuring Methods, Part 2: general examination, electrical continuity and contact resistance tests, insulation tests and voltage stress tests ($17.35)

IPC-R-700B (Sep 1977) Modification and Repair for Printed Boards and Assemblies ($3.00)

IPC-S-815 (Nov 1977) General Requirements for Soldering of Electrical Connections and Printed Board Assemblies

IPC-SM-840 (Oct 1977) Qualification and Performance of Permanent Polymer Coating (Solder Mask) for Printed Boards

NFPA No. 79 (1977) Electrical Standard for Metalworking Machine Tools ($4.00)

MIL-STD-883B (Aug 1977) Test Methods and Procedures for Microelectronics

UL 83 Revision Review Copy (Oct 1977) Thermoplastic-Insulated Wires

have available a few copies each of:

ANSI-Y10.1-1972 Glossary of Terms Concerning Letter Symbols ($2.25)

ANSI Y10.20-1975 Mathematical Signs and Symbols for Use in Physical Sciences and Technology ($5.00)

ANSY Y32.14-1973 Graphic Symbols for Logic Diagrams (two-state devices) ($6.00)

EIA Industrial Electronics Bulletin No. 12 (Nov 1977) Application Notes on Interconnection Between Interface Circuits Using RS-449 and RS-232-C ($4.25)

EIA Std. RD-449 (Nov 1977) General Purpose 37-position and 9-position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange ($9.50)

IEEE 270-1966 Proposed Standard of Definitions of General (Fundamental and Derived) Electrical and Electronics Terms ($7.60)

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

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
151-0213-00 151-0222-00	Fairchild, S.S.S.	Transistor	Matt Porter, 7461

The remaining users of these transistors recently switched over to substitutes, when the two qualified vendors were unable to produce the parts. Because we now have no approved sources, further use of these devices is not recommended, especially when there are less expensive parts available for new uses. If you have any questions about these two parts, or their substitutes, please call me.

Tek P/N	Vendor	Description of Part	Who to contact
151-0325-00	Motorola, National, Fairchild	Transistor	Matt Porter, 7461 Gary Veatch, 6402

We have had supply problems with this part in the past, and currently find ourselves in a shortage situation with no relief in sight.

The 325 is a fast switch with a special requirement of a high beta at a low V_{CE}. The raw part 151-0221-00 should be used instead of the 151-0325-00 if possible. The cost is the same, supplies are much better, and the specifications are the same except for the one beta requirement. If your area can use the 151-0221-00, you should modify to that part and notify one of us as soon as possible.

Tek P/N	Vendor	Description of Part	Who to contact
161-0066-00	Belden	Cable assembly, power	Vince Bail, 6938

There is intermittent contact in some of these power cords, caused by contacts in the female connector being bent too wide. Due to this problem, all power cords received since September, 1977 have been 100% inspected for conductor resistance ($\leq 75\Omega$). The cords are also checked for insertion force and excessive flash in the contact area of the female ends.

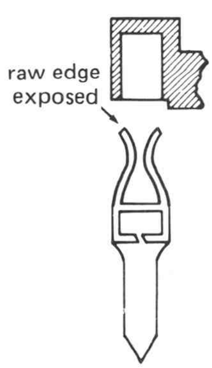
Screening is being done to keep ahead of critical shortages, however this has considerably reduced available stock. The vendor has been contacted for corrective action. Please continue using the cords, replacing defective ones as found.

Tek P/N	Vendor	Description of Part	Who to contact
105-xxxx-xx	Tek-made	**Cam drum, general**	Neill Martin, 7642

A problem was detected in several instruments run through humidity test or calibrated during periods of high humidity. The problem was identified as leakage in 10 meg circuits, and was caused by the water soluble cutting oil used during the cutting of the logic on the cam drum. The leakage is between adjacent low frequency contacts and through the cutting oil.

As of January 15, 1978, all cut logic drums will be washed by Switch Production, in order to remove the cutting oil. This standard procedure is to insure that no critical applications will be overlooked. (It is not necessary to wash cut logic on high frequency contact applications since there is no leakage path.)

Tek P/N	Vendor	Description of Part	Who to contact
136-0578-00	TI	IC socket	Larry Berry, ext 5417 Emerson Beer, ext 5034



We have discovered a problem with 136-0578-00 IC sockets. When the IC is installed into the socket, the leads fit improperly and the contacts become bent. This has particularly been a problem with the corner contacts, where the raw edge of the contact is visible on defective components.

New parts --100% inspected by TI -- have been ordered. When they come in, we will purge our existing stock. Other sockets are also being checked. Until then, we recommend that low profile IC sockets be closely monitored. Manufacturing Engineering can help if there are any questions with these or other sockets with similar problems. For further information, please contact either of us.

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	No.	Description	When available	Tek P/N	Approx. cost	Engineer to contact
		analog devices				
National	AF150	Active filter, Q_{min} = 500 Hz/Hz Freq. range$_{min}$ = 100kHz	now	—	$ 5.00	John Hereford, 6700
National	LM346	Programmable quad op amp	now	—	1.00	John Hereford, 6700
TI	TL321	Single supply op amp (single version of LM358)	now	—	0.30	John Hereford, 6700
TI	TL331	Diff. comparator (single version of LM393)	now	—	0.30	John Hereford, 6700
TI	TL489	Five step analog level detector (200 mV steps)	now	—	0.60	John Hereford, 6700
Fairchild	CCD321A	445/910-bit analog CCD shift reg.	now	—	60.00	John Hereford, 6700
Signetics	NE5539	1.2 GHz, 800V/μsec op amp	Aug.	—	5.00	John Hereford, 6700
Signetics	NE5532	Dual NE5534, low noise (5 nV/$\sqrt{Hz}$), low distortion op amp	soon	—	1.50	John Hereford, 6700
		digital devices				
National	74C923	20-key keyboard encoder	now	—	3.00	Wilton Hart, 7607
National	LF13333	2 normally open & 2 normally closed JFET switches	now	—	2.50	Wilton Hart, 7607
Harris	HM-6504	4069 x 1 CMOS RAM	Apr.	—	—	Wilton Hart, 7607
National	8060	SC/MP II microprocessor	now	—	—	Carl Teale, 7148
		electromechanical devices				
C & K	9221/series	Toggle switch, UL, VDE, 10 A, 125V; 5 A, 250V	now	—	2.50	Joe Joncas, 6365
Schurter	031.1673	Fuseholder body, low profile	now	204-0832-00	0.37	Joe Joncas, 6365
Schurter	031.1653	Fuseholder body, high profile	now	204-0833-00	0.37	Joe Joncas, 6365
Schurter	031.1666	Fuse carrier, 3 AG	now	200-2264-00	0.25	Joe Joncas, 6365
Schurter	031.1663	Fuse carrier, 5 x 20 mm	now	200-2265-00	0.25	Joe Joncas, 6365
		resistor, capacitor, optoelectronic devices				
resistor, fixed						
Dale,Kelvin, Ohmite,RCL		2Ω, 5% 5 watt w.w.	Mar.	308-0119-00	0.14	Ray Powell, 6520
A-B (only)	BB3605	36Ω ± 5%, 1/8 watt carbon	now	317-0360-03	0.08	Ray Powell, 6520
A-B (only)	BB1015	100Ω ± 5%, 1/8 watt carbon	now	317-0101-03	0.08	Ray Powell, 6520
CTS,Dale	MSP10CO1151G	150Ω ± 2%, SIP 7 res. 8-pin	Apr.	307-0611-00	0.30	Ray Powell, 6520
Caddock	T-1794-5	1M, 10K, 1KΩ ± 1KΩ	Apr.	307-1118-00	1.69	Ray Powell, 6520
Caddock	T-1794-4	3K, 5K, 1K ± 1KΩ	Apr.	307-1119-00	2.25	Ray Powell, 6520
Dale,Kelvin	NS1015000G	1500Ω ± 2%, 10W non Ind.	Apr.	308-0809-00	0.50	Ray Powell, 6520
Dale,Kelvin	NS1018000H	1800Ω ± 3%, 10W non Ind.	Apr.	308-0810-00	0.50	Ray Powell, 6520
Dale,Mepco,Electra	MFF1226G28000F	2.8KΩ ± 1% TO 1/2W	Mar.	323-0236-00	0.04	Ray Powell, 6520
A-B	HB1305	13Ω ± 5%, 2W	Mar.	305-0130-00	0.11	Ray Powell, 6520
A-B	CB2773	270MΩ ± 30%, 1/4W	Mar.	307-0620-00	0.60	Ray Powell, 6520

PRODUCT SAFETY NOTE NO. 32

6 FEBRUARY 1978

Subject: One-hundred-percent production-line testing of protective-ground continuity.

As you know, nearly all our power-line operated products have three-wire cords, in which the third (green-and-yellow-insulated) wire serves as protective ground. This conductor, for safety purposes, is intended to carry leakage and fault currents only. An open in the circuit of this conductor, or a wiring interchange involving this conductor, is very serious since it removes important protections provided by this conductor.

Opens and interchanges involving the protective-ground conductor are usually not obvious--and therefore such faults are subtle and insidious. This adds to the danger of such power-cord faults.

Power-cord makers and Tektronix, Inc., have mounted massive control efforts to eliminate these protective-ground-circuit faults. Nevertheless, such faults appear recurrently, at times appearing to be almost cyclical in nature.

Accordingly, we must make routine one-hundred-percent protective-ground continuity tests of our power cords as installed in our products. This involves every production line that uses three-conductor power cords with protective-ground conductors.

The tests must check for ground-circuit continuity from the product enclosure to the ground pin of the power plug.

If the power cord is detachable, the test must be made with the single individual power cord that we ship with the product.

The single topic of this Product Safety Note is: Assurance of continuity of the protective-ground connection, from product enclosure to power-plug ground pin.

In some areas, this test is already being taken care of fully. You are already in compliance with this requirement if all of the following are true:

- You have an EPA Electronics, Inc., Model M100AV HI-POT tester;
- You perform one-hundred-percent routine dielectric-withstand tests on all your products with this tester; and
- In performing these tests, you always connect the tester front-panel CHASSIS GROUND terminal only to the chassis of the product you are testing.

Under the above circumstances, an open in the power-cord protective-ground conductor results in obvious nonfunctioning of the tester. A power-cord wiring interchange involving the protective-ground conductor results in a fault indication (or possibly nonfunctioning of the tester).

In conclusion, we have an unequivocal duty to assure that the protective-ground circuit interposes its intended protection between the product user and functionally insulated live parts of the product. We must positively meet this responsibility by diligently instituting the continuity test in every product line. Product Safety Engineering staff is available to help each product line institute this test. A quick phone call will get one of our engineering staff to aid you in implementing this test.

Pete Perkins
Product Safety Engineering Manager
58-262; Ext. 7374

Eddie Richmond
Product Safety Engineer
58-262; Ext. 7374

PRODUCT SAFETY NOTE NO. 33

14 FEBRUARY 1978

Subjects: Fuse-replacement warning; fuse type and ratings markings.

1. This Product Safety Note refers to new designs and redesigns.

2. UL requires a warning which reads (depending upon which standard you consult) more or less as follows:

   "CAUTION - FOR CONTINUED PROTECTION AGAINST FIRE HAZARD, REPLACE ONLY WITH FUSE OF SAME TYPE AND RATING."

   We believe the following is a better marking, and suggest you use it:

   "CAUTION - FOR CONTINUED FIRE PROTECTION, REPLACE ONLY WITH FUSE OF SPECIFIED TYPE AND RATINGS."

3. Fuse type and ratings typically appear in a table, along with voltage settings and ratings. (This, of course, is not the only arrangement.)

4. As to fuse type, we have after consultation with UL people withdrawn our previous recommendation that you include "3AG" or "5 X 20 mm" or such data. (There's nothing wrong with including these data--it's just that they're not required.)

   WE WOULD HAVE TO GO FURTHER INTO THE PHYSICAL TYPE OF FUSE ONLY IF WE HAVE A "UNIQUE" OR AT LEAST A "VERY UNUSUAL" PHYSICAL KIND OF FUSE.

   Type, then, appears to refer principally as to whether a fuse is FAST or SLOW.

5. Fuse ratings include both voltage and current ratings. (That's why, under Item 2 above, we suggest changing the word "rating" to "ratings".)

   Voltage ratings are often 250 volts. But a surprising number of our fuses are rated for 125 volts. 125-volt-rated fuses are not suitable for 250-volt circuits. Please check this point as to fuses you intend to use.

6. In international standards, various letter symbols indicate the time-current characteristics of fuses to be used. That is, whether the fuses for example are fast or slow. In particular, "F" is for a FAST fuse, while "T" is for a SLOW (time-lag) fuse.

   We understand that two very leading U.S. electronic-instrument manufacturers now use some form, or some part, of this system. We expect foreign customers to require us to use such indications. So for your fuse (and voltage-setting) table, use F(FAST) and T(SLOW) for fast and slow fuses respectively. If space prohibits this (very unlikely), just use F or T.

7. Sometimes the fuse type-and-rating information, or a part of it, can well be included in the fuse-replacement warning. One very unusual situation appeared when the same exact fuse was intended for all voltages, etc. So here we could use a replacement warning like:

   "CAUTION - FOR CONTINUED FIRE PROTECTION, REPLACE ONLY WITH 250-V 2-A T(SLOW) FUSE." No fuse-replacement table would then be required.

   A more likely situation is one where the fuse voltage rating remains at 250 volts, but the current ratings and the time-current characteristics differ from one supply-voltage setting to another. If you wish, you can in such situations make the warning read something like:

   "CAUTION - FOR CONTINUED FIRE PROTECTION, REPLACE ONLY WITH 250-V FUSE OF SPECIFIED TYPE AND CURRENT RATING." The type, such as F(FAST) or T(SLOW), and the current rating can then appear along with voltage-setting data in a table.

   Obviously, many sensible variations can occur.

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