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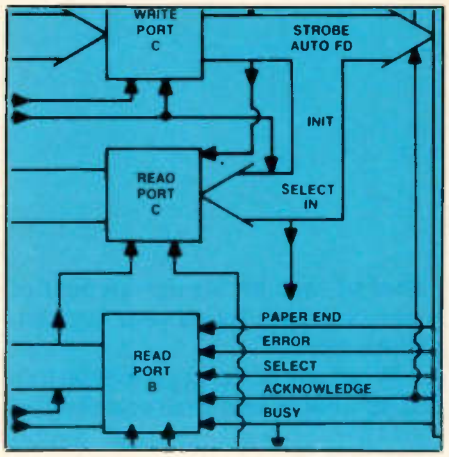
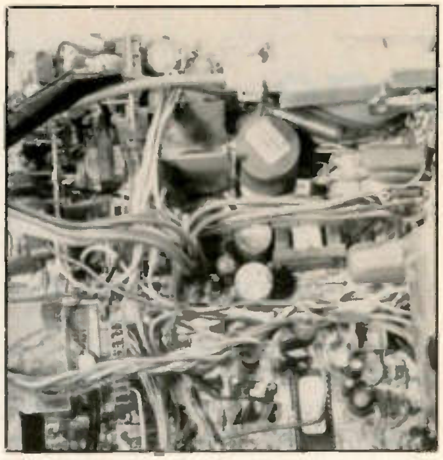
Contents

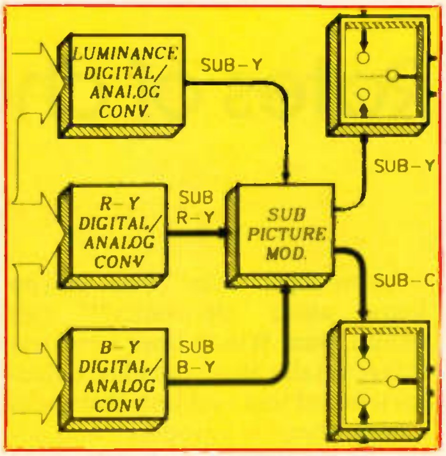
Volume 10, No. 12 December 1990



page 42



page 18



page 54

FEATURES

DEPARTMENTS

ON THE COVER

The whole is greater than the sum of the parts. With a consumer electronic product, that's true as long as all the parts are working. When a product malfunctions, you want to get replacements for all those parts that have failed as quickly as possible. In order to do so, you have to be able to determine who manufactured the product and where the manufacturer is located. It's also helpful if you have some alternative sources of supply. *(Cover courtesy Philips ECG).*

THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS
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Editorial

Rates of change

In his department "What do you know about electronics?" this month, Sam Wilson does a reckless thing; he talks about calculus. Calculus is one of those subjects that elicits a hush when it's introduced into polite conversation—which isn't often.

Unfortunately, calculus is one of those subjects that isn't usually taught at say the high school level, so except for the precocious few who have had advanced math in high school, and college graduates, calculus is terra incognita. And even among college educated people, calculus is ordinarily only studied by the math, science and engineering types, and a few business majors. Because of this, calculus, which is a branch of math that applies to almost every area of human existence and endeavor, is not well known or understood.

Calculus gets mentioned in this issue because "What do you know . . ." is about induction, and induction of a voltage in a wire caused by a magnetic field is caused by the rate of change of the magnetic flux where the wire is. Calculus is the branch of math that, among other things, studies rates of change.

Calculus does, in fact get difficult. I took several years of calculus in college, including advanced calculus for engineers, and some of the material was awfully heavy going. But it isn't necessary to get bogged down in the advanced stuff. A grasp of the basic concepts of calculus helps immensely in understanding much of electronics. For example, the concepts of an integrating circuit, or a differentiating circuit, are meaningless without at least a passing acquaintance with calculus: integration and differentiation are calculus terms.

Fortunately, though, because we modern folks regularly drive a car, or fly or otherwise travel at high speed, we have at hand the basis of an easily grasped appreciation of the idea of differential calculus.

Lets take for starters the case when you get the family car out on the road, and travel, say 50 miles. If it takes you an hour to travel that distance, your average speed is fifty miles per hour. You calculate that by dividing the 50 miles by one hour.

Expressed in the terms used by calculus the distance traveled was Δs. The time you took to travel that distance was Δt. The letter s stands for distance; the letter t stands for time. The greek letter Δ stands for a small amount of a quantity. The mathematical expression would be:

$$\text{Average speed} = \Delta s/\Delta t = 50\text{ miles}/1\text{ hour} = 50\text{ miles per hour.}$$

But as the driver of a car, you know that that's just an average. Over the city streets you travel for the first few miles to get to the highway your speed might be 20 mph. At the stop light there might be several seconds to a minute where your average speed will be zero.

If you were to graph your distance versus time, you'd have a graph that would be generally increasing in height (the distance coordinate) as you moved toward the right (the time coordinate). It would rise quite rapidly as you went fast, rise less rapidly when you're going slower, but be flat whenever you were stopped (time is going by, but the distance you have traveled doesn't increase). If you have, in fact averaged 50 mph during the hour, at the point on the graph where the time is one hour, the distance traveled would show 50 miles.

If you were to take any segment of the graph and divide the distance traveled (Δs) by the time it took to travel that little bit of distance (Δt), you would find the average speed you traveled during that time. If you make the amount of time smaller and smaller until the time is almost, but not quite, zero, then divide the tiny distance you traveled during that instant of time by the tiny amount of time, you have found your instantaneous speed.

When you perform the mental leap of an almost-zero time and the tiny distance covered in that almost nonexistent amount of time, the Δ's become d's in calculus, and the expression $\Delta s/\Delta t$ becomes ds/dt. It's really not a hard concept to grasp; your speedometer reads directly in ds/dt. When you look briefly at your speedometer and it says 30 mph, it doesn't matter whether you're cruising steadily at 30 mph, or accelerating sharply from 0 to 60 in 7.5 seconds, or braking from highway speed, at that instant in time, your speed is such that if you continued at that speed for one hour you would cover 30 miles.

The reason that this particular branch of calculus is called "differential" calculus is that we are dealing with the idea of small differences (of time, of distance, of current, of voltage; you name it). And the reason it is so important in electronics is that much of what goes on in electronics is very readily described in terms of calculus. The definition of resistance, R, is found in the mathematical expression $V = IR$. The definition of inductance is found in the mathematical expression $V = L(di/dt)$, where di/dt is the instantaneous change of current with time. The definition of voltage in terms of capacitance involves an expression from the integral calculus, so we won't go into it here.

While terms from calculus, or any other less-used discipline, may be unfamiliar at first, the economy of expression usually ultimately leads to a better understanding of the subject.

Nils Conrad Persson

Semiconductor distribution conference announced for Las Vegas

The industry's first semiconductor distribution conference will be held in Las Vegas, Nevada from April 29 through May 2, 1991, it has been announced by conference Chairman Bernard Marren.

Marren said that the conference will provide a new unique, and cost-effective approach to top-level, top-quality management meetings between manufacturers of active components and their distributors. The conference headquarters will be at Caesars Palace in Las Vegas, Nevada, concurrent with the Electronic Distribution Show and Conference at the Las Vegas Hilton.

The EISC is sponsoring the Semiconductor Distribution Conference as an opportunity for manufacturers of memories, integrated circuits, and other active components to meet, talk and socialize with their distributors and peers in an informal, unstructured atmosphere.

The organizing committee has made arrangements for a group of deluxe suites at Caesars Palace to be available to semiconductor companies, to facilitate their taking advantage of the industries distribution marketplace. Participation commitments have been made to date by Hitachi, Fujitsu, and NEC.

EDS 91 mail exhibit and suite literature and applications

Invitational brochures for exhibit/conference participation in the 1991 Electronic Distribution Show and Conference (EDS '91) have been mailed to manufacturers, announced David L. Fisher, Executive Vice President of the Electronic Industry Show Corporation.

EDS 91, the marketplace of and for electronic distribution, will take place at the Las Vegas Hilton Hotel, in Las Vegas, Nevada. Conferences and seminars will start on Monday, April 29, and exhibits will open on Tuesday, April 30, continuing Wednesday and Thursday, May 1 and 2.

Over 6,000 management, sales and marketing people involved with electronic distribution attend EDS each year; over 350 companies exhibit. A number of new ancillary programs are being introduced for 1991 to stimulate attendance, especially a series of New Market Opportunities seminars.

Some 70 companies signed up for their exhibit and conference space at EDS '91 during EDS'90, Fisher said.

EDS is sponsored annually (on a not-for-profit basis) by the Electronic Industries Association Components Group (EIA), the National Electronic Distributors Association (NEDA), and the Electronics Representatives Association (ERA). It is the industry's oldest trade show, having operated since 1937. ■

Literature

New application note on how to select and use the new lines of high performance DMMs

A new application note, now available at no charge from John Fluke Mfg. Co., Inc., introduces buyers and regular users of digital multimeters (DMMs) to the high performance functions and capabilities now being found in these products. The note, "A Guide to High Performance DMMs," provides DMM purchasers with helpful selection criteria and current DMM users with information to maximize the value of their instruments. The application note begins with a definition of a high performance DMM, explaining that high performance entails going beyond the usual volts, ohms, and amps measurements. Also included are sections on extended measurement capabilities, recording modes, special features and accessories. A chapter on selecting true-rms and averaging meters offers helpful information on matching the technician and application with the right meter.

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Application guide on how to expand function generator capability using arbitrary waveforms and a DSO

A new guide entitled "More Function Generator Capability with Arbitrary Waveforms," is now available from John Fluke Mfg. Co., Inc. The guide explains how to recreate waveforms captured with a digital storage oscilloscope (DSO) on the Philips PM 5138 Arbitrary Waveform/Function Generator without any programming. Also included in the guide are sample applications using the Philips PM 5138 10 MHz function generator with arbitrary waveform generator capability, and the PM 3375 100 MHz, 250 MS/s, digital storage oscilloscope. Applications include bar code reader testing, power step supply response, and the testing of a Touch-Tone (DTMF) Signal.

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1991 Jensen master catalog

The new 1991 Master Catalog from Jensen Tools Inc. offers quality products for design, assembly, testing and repair of electronic instruments and systems. This color illustrated catalog contains 232 pages of tools, testers, meters, scopes and probes, soldering/desoldering supplies, power analyzers, regulators, adapters, work holding devices, lighting/optical aids, carts, cases, shipping containers and more.

Circle (31) on Reply Card

New application guided demystifies EBR (Effective Bit Resolution) in digital storage oscilloscopes

A new application guide "EBR: The Truth About Effective Bits," from John Fluke Co., Inc., brings new insights into Effective Bit Resolution which has become one of the most mystical and, perhaps mythical characteristics of the Digital Storage Oscilloscope. EBR has caused much confusion in the test and measurement community and, while this free application guide helps to demystify the subject of EBR, it also provides valuable information on this relatively new characteristic.

The term "Effective Bits," is common in the component industry to describe the relative accuracy of a single A/D converter component, without the influence of all other circuitry that makes up for a complete DSO.

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Federal warranty's newsletter advises dealers about legislation

The Legislative Watch is a featured column in Federal Warranty Service Corporation's quarterly newsletter, Service Contract. This issue, the second published this year, reports about legislative attempts to curtail service contracts in California, Florida, and New York. In addition the issue features an editorial questioning who benefits from all these restrictive legislation attempts, written by Federal Warranty Service Corp. President, Michael Stevenson. Other articles in the four-page newsletter offer selling tips. The newsletter is available free to consumer electronics dealers and others interested in offering service contracts to their customers.

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ELECTRONIC
Servicing & Technology

Electronic Servicing & Technology is edited for servicing professionals who service consumer electronics equipment. This includes service technicians, field service personnel and avid servicing enthusiasts who repair and maintain audio, video, computer and other consumer electronics equipment.

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Member, Audit Bureau of Circulation

Member, Electronic Servicing Dealers Association

EDITORIAL CORRESPONDENCE
P.O. Box 12487 Overland Park, KS 66212
913-492-4857

Electronic Servicing & Technology (ISSN 0278-9922) is published monthly by CQ Communications, Inc., 76 N. Broadway, Hicksville, NY 11801. Telephone (516) 681-2922. Second class postage paid at Hicksville, NY and additional offices. Subscription prices (payable in US dollars only): Domestic—one year $24, two years $36. Foreign countries—one year $30, two years $42.

U.S. Government Agencies: Subscriptions to Electronic Servicing & Technology are available to agencies of the United States government, including military services, only on a cash with order basis. Requests for quotations, bids, contracts, etc. will be refused and will not be returned or processed.

Postmaster: Please send change of address notice to Electronic Servicing & Technology, 76 N. Broadway, Hicksville, NY 11801.

CQ Communications, Inc. is publisher of CQ The Radio Amateur's Journal, Popular Communications, Modern Electronics, CQ Radio Amateur (Spanish CQ), CQ Amateur Radio Equipment Buyer's Guide, CQ Amateur Radio Antenna Buyer's Guide, and Electronic Servicing & Technology.

Indexing your business to inflation

By William J. Lynott

If you're like most of us, you've become relatively comfortable with today's inflation rates. After all, when President Carter left office in 1981 the inflation rate was a whopping 12%. Today, it's less than half that.

That's the way it is with us. We tend to have short memories. Everything, as they say, is relative. While 5% or 6% inflation seems quite acceptable to many people today, it was enough to cause President Nixon to impose national wage and price controls as recently as the seventies. Remember?

The reason, of course, was that we had come to take annual cost-of-living increases of 1% or 2% for granted over a period of many years. An increase in the inflation rate to 6% was almost reason for panic. But we've been seeing inflation rates in that neighborhood for a long time now. So, we've developed a certain immunty. And that's not good.

Consider the rule of 72—a principle taught in Economics 101 that allows you to take a peek at the future all by yourself. The rule of 72 allows you to predict how long it will take for prices to double at any given inflation rate. To use it, just divide the anticipated inflation rate into 72. For example, let's say that you feel inflation will average 6% over the next few years. Seventy-two divided by six equals twelve. At a six percent inflation rate, then, prices will double every twelve years.

Shades of Benjamin Franklin. A penny saved will hardly be worth it.

That $7.50 haircut will cost you $15; the cheapest new car on the market will cost you $18,000 or $20,000; that tuner that you now pay $50 to put in your inventory will cost you $100. And so on.

A gloomy picture isn't it? Well, yes, unless you happen to be lucky enough to own the best inflation hedge there is. The one that's better than tax shelters, deferred annuities, paychecks from stingy bosses, or a brother-in-law with inside information. What is it? Why, our business, of course.

That's right. The best inflation hedge you're ever likely to find is a growing, profitable business of your own. A healthy business has the ability to adapt to its environment—to grow in earning power at least as fast as the inflation that feeds it.

And there is no type of business for which this is more true than the service business. In our service-oriented economy, a successful service business is in a position to benefit from a sort of synergistic action between itself and the economy.

Of course all this isn't going to happen by itself. As a service dealer, you've got to hold up your end of the bargain if you want your business to do its part.

For example, take the prices that you now charge for labor. You don't need me to remind you that your labor rates are a vital part of your business success or that customers are already unhappy with high prices and tend to look unkindly on price increases.

In the real world, however, what you take in your business must increase at least as fast as what you pay out. Thus, the need for increasing your labor rates periodically will never go away, so long as any rate of inflation exists.

As I have written before in this column, setting the correct labor rate for your business requires some work. Costs must be analyzed carefully. You cannot know how much to charge for any product or service until you know precisely how much that product is costing you. Labor is certainly no exception to this basic rule.

There are any number of methods for determining your true cost for labor. Dealers who like to work with flat rates often prefer to deal with average cost-per-call analyses. Those who like to charge for labor on a straight time basis probably would do better with a more detailed analysis that includes computing the average cost per productive hour (time actually spent by technicians on repairs). Once cost-per-hour is known, you can compute the mark-on needed to meet your profit objective.

Regardless of the method you use, be sure to include all expenses incurred in running the business (except those directly attributable to parts operations), not just technician wages.

I placed emphasis on productive time with a purpose. If you haven't calculated the ratio of technician hours-worked versus hours actually spent on repairs, you're probably in for a shock. Independent studies over the years indicate that productive time averages only about 55% after deducting time for check-in, driving time, coffee breaks, training, etc. The latest studies suggest that this figure may actually be getting worse instead of better over the years. I hope you're beating the average in your business.

Oh, I know that there are many "simpler" ways to go about setting service rates. One system that seems to be very popular these days calls for "charging the same rate as the guy down the street."

The only trouble with that system is that the guy down the street may not understand about inflation either, and may be setting his rates the same way. In that case, the two of you may well wind up marching off into financial oblivion together. ■

Lynott is president of W.J. Lynott, Associates, a management consulting firm specializing in profitable service management and customer satisfaction research.

Effects of storage and dormancy on components

By Victor Meeldijk

Just about every packaged item in the supermarket today is dated for optimum use, batteries have "best if used by . . ." and sugar packages say "quality maintained indefinitely if tightly closed and stored in a dry place." Will those electronic assemblies and components in your stockroom last indefinitely? Do the parts have to have special storage conditions, or be conditioned before use?

Are there tests that you can do to find weak parts that will fail at a later time? Should you avoid designing in certain devices if the system will be dormant for a long time? Continue reading for the answers to these questions.

In the military whenever hardware is procured a support analysis is done which includes the storage time period or perishability of component materials. Electronic hardware and materials, just like foods or medicines, have life limitations which may be shortened or extended depending upon the conditions under which they are stored. The following text describes general characteristics of devices under different storage conditions.

Meeldijk is the Reliability/Maintainability Engineering Manager Diagnostic Retrieval Systems, Inc., Oakland, NJ.

Carbon composition resistors

Fixed composition resistors are made up of a mixture of carbon particles and a binder with wire leads embedded in this resistance element. This is surrounded by a molded insulating case. This insulating case, usually made up of a phenolic plastic material, absorbs moisture after periods of storage in humid environments which causes a resistance value change. A humid storage condition also results in lead corrosion which causes solderability problems.

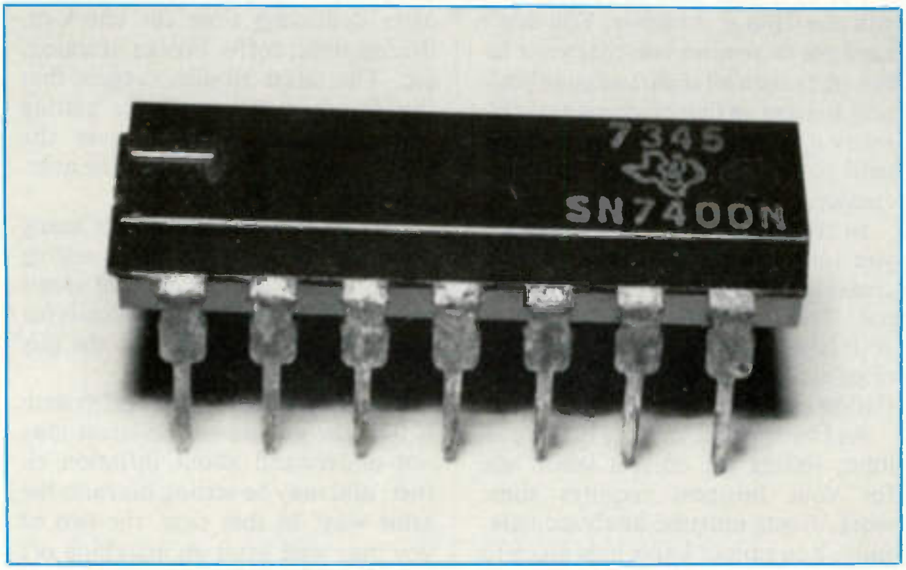

Figure 1. Storage in humid conditions can result in oxidized leads.

These effects can be reversed by either baking out the parts at a high temperature, or by operating the parts so self-heating will liberate the trapped moisture.

Conditioning out of tolerance resistors includes baking them in a dry oven at temperatures of 100°C for durations based upon the size of the resistor. One-eighth watt resistors are baked for 25 hours, one-quarter to one watt resistors for 130 hours and two watt resistors for 130 hours.

Film resistors

Fixed film resistors are usually made up of a resistive material, either carbon or metal, deposited on the inside or outside of a glass tube, and spirally cut to achieve specific resistance values. End caps with leads are connected to the resistance element and a molded plastic case, or epoxy coating adds strength to the resistor and helps to seal out moisture. Unlike carbon composition resistors, moisture effects vary according to the properties of the materials that are used and the device manufacturing techniques.

Moisture related problems are generally observed in devices with manufacturing defects, although just like carbon composition resistors, lead corrosion which causes solderability problems can occur. Manufacturing defects can result in increased component resistance and a decline in insulation resistance. Open circuits from end cap problems, and swelling of the resistor from absorbed moisture can also occur.

Wirewound resistors

Fixed wirewound resistors are formed by winding special alloy resistance wire on a ceramic core. Connections to this wire coil are made with either leaded end caps or metal terminal bands. This element is then either sealed in a molded case, encased in a metal housing and potted with a cement mixture, or coated with enamel, silicone or cement.

Wirewound resistors are the most stable resistors and like film resistors, failures are usually due to manufacturing defects. Moisture trapped inside the resistor, are allowed to enter by porous coatings or poor seals, can cause leakage between turns and layers which can result in insulation breakdown and short circuits. Corrosion and electrolytic action can result in opens between the resistance wire and the end terminals. Defects in the wire can also result in open circuits. Wire-wound resistors, because of their stability even under extreme environmental conditions, are preferred for dormant applications.

Variable resistors

Variable resistors are highly unstable devices and their tolerance values reflect this. Variable carbon composition resistors are the least stable of all and can have a resistance change of 20% in a year. Their maximum storage temperature is 70°C. Of the other types of variable (trimmer) resistors available the most stable is the wirewound type.

Fixed paper and plastic film dielectric capacitors

Paper and plastic film capacitors are made by interleaving thin films of dielectric material with metallic foils which serve as the electrodes. The resulting material is spiral wound into a tight cylindrical roll with leads attached by soldering or welding. Special low ESR (equivalent series resistance) application capacitors may have a total of four leads, two leads for each connection. Moisture absorbed by capacitors can cause parametric changes, or even reduced life with early failures if moisture penetration is significant. The most notable effect is a decrease in insulation resistance. Paper dielectric capacitors are not recommended for use in humid dormant applications. Plastic dielectric capacitors are non-absorbent.

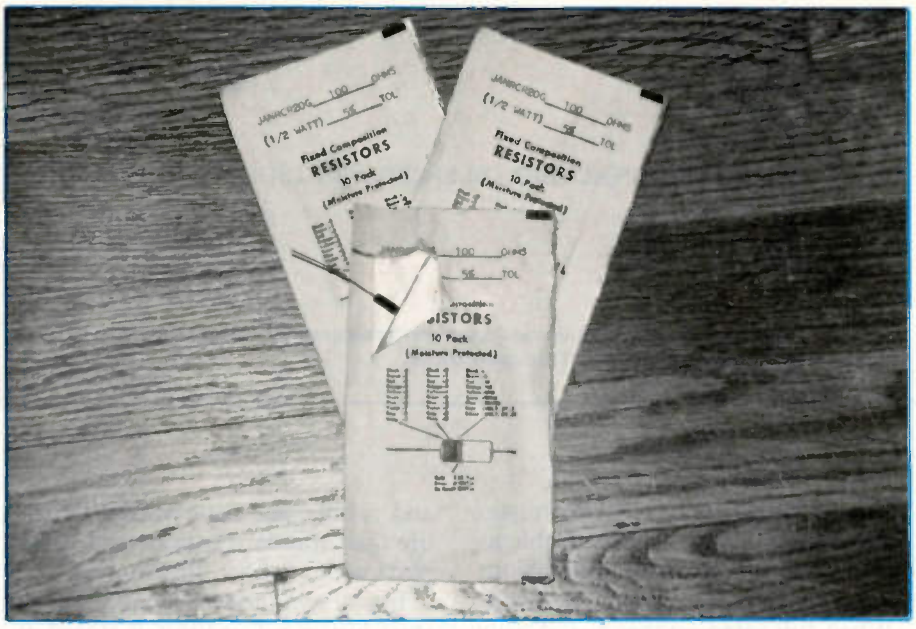

Figure 2. Carbon composition resistors are stored in special moisture resistant packages.

Fixed glass and mica dielectric capacitors

These capacitors are made up of stacks of non-flexible dielectric materials. These thin layers of dielectric are stacked between multiple electrodes with alternate electrodes connected in parallel. Mica is the best known capacitor dielectric because it has excellent temperature coefficient characteristics and very little aging effects with operation. Glass dielectric capacitors have electrical characteristics similar to mica capacitors. They have excellent long term stability, a low temperature coefficient and a good reliability history.

Fixed ceramic dielectric materials

Disk capacitors consist of a thin coating of metallic paint fired on each face of a ceramic disk. Parallel leads are soldered to the metallic electrodes. The unit is first encapsulated in resin which is then impregnated with a high melting point wax. Tubular designs have a ceramic core with silver electrode bands fired on the inside and outside surfaces. Capacitance is formed between the silver bands with the ceramic as dielectric.

Multilayer ceramic capacitors consist of multiple films of a noble metal spaced with thin films of ceramic. The assembly is then fired to give a monolithic construction. These multilayer capacitors are the type used for chip capacitors. Ceramic materials have practically no moisture absorption. They can operate through their full temperature range at relative humidities up to 95%. In storage and dormant applications however excessive moisture should be avoided as the encapsulation may allow moisture to enter into the capacitor. This may result in silver ion migration and when the capacitors are used at a later time short circuits may occur.

Fixed electrolytic capacitors

Electrolytic capacitors are either of an aluminum or tantalum construction. While aluminum capacitors are made up of aluminum foil, tantalum capacitors can either be solid or wet dielectric, non-solid foil or non-solid sintered slug types. Aluminum electrolytic capacitors consist of an aluminum foil rolled onto a porous spacer. This spacer, which separates the capacitor anode and cathode, is impregnated with an aqueous solution of ammonium bor-

TABLE 1
EXAMPLES OF SAFE AND UNSAFE CLEANING SOLVENTS TO USE WITH ALUMINUM ELECTROLYTIC CAPACITORS

SAFE (ACCEPTABLE) CLEANING SOLVENTS

ACETONE
TOLUOL-HEXANE-ETHYL-ACETATE
BUTYL ALCOHOL
ETHYL ALCOHOL
LACQUER THINNER
METHYL ALCOHOL
MINERAL SPIRITS
PROPYL ALCOHOL
XYLENE

UNSAFE (UNACCEPTABLE) CLEANING SOLVENTS

CARBON TETRACHLORIDE
CHLOROFORM
CHLOROTHENE
FREON
METHYLENE CHLORIDE
PERCHLORTHYLENE
TRICHLOROETHANE
TRICHLOROETHYLENE

Note: If epoxy end sealed capacitors are used exposure to unacceptable solvents should be less than two minutes to prevent degradation of the epoxy barrier.

ate, boric acid and glycol electrolyte. This type of capacitor has problems in storage and dormant applications because the oxide film deforms. When full rated voltage is suddenly applied the capacitor fails.

After years in storage the capacitors can also dry out. Computer grade capacitors with a phenol cap and rubber seal have a longer shelf life than standard commercial grade parts with a rubber like cap seal.

In storage, these capacitors have a shelf life over five years if stored at temperatures lower than 40°C. Higher temperatures will decrease shelf life. After three years of storage, the capacitors should be checked out at room ambient for excessive leakage current. Should the leakage be higher than the specified limit, the capacitor can be reconditioned, that is "reformed" by applying a voltage to the capacitor. This reconditioning technique is detailed in Sprague Electric Company Application Note 3499.1.

Solid tantalum dielectric capacitors

These capacitors consist of a porous tantalum pellet, or wire, which is the anode, or electrode. The surface of the anode is electrochemically converted to a tantalum oxide which serves as the dielectric. This oxide is then coated with a semiconductor oxide which is a solid form of electrolyte. Solid tantalum chip capacitors are similarly designed except a porous tantalum slab versus a pellet, or wire, is used as the anode. Solid tantalum electrolytic exhibit excellent storage life characteristics. The failure modes of solid tantalum capacitors in storage include high leakage current, high dissipation factor, short circuits or out of tolerance conditions. These failures are mainly caused by various manufacturing defects.

Non-solid (wet) tantalum dielectric capacitors

As previously mentioned there are two types of non-solid tantalum capacitors. The foil type consists of a foil anode treated to form a tantalum oxide dielectric. Porous spacer material is then used to form a cylinder capacitor with wire leads. A weak acid or base is used as the electrolyte. Sintered slug capacitors are similar in design except a sintered slug of tantalum is used as the electrode. In wet types the major storage problem is leakage of the electrolyte, where the electrolyte leaks past the center seal of the capacitor. This leakage can cause short or open circuits and out of tolerance leakage conditions. Defects in the capacitor insulation can result in shorts or out of specification dissipation factor. Open circuits can be caused by faulty connections to lead wires.

Variable capacitors

Variable capacitors are highly unstable devices as revealed by their tolerances and because they have movable shafts are susceptible to environmental degradation. While elastomer O-ring seals may be used, they cannot seal the capacitors from the effects of moisture, temperature, shock, vibration and contaminants.

The variable capacitor to use with the best stability is made of half moon rotors and stators whose overlap determines capacitance. Variable ceramic dielectric capacitors, with a single stator and rotor for each section, are made up of ceramic material impregnated with transformer or silicon oil. Pure silver is fired and burnished on top of the base of the stator in a half moon pattern. The rotor, usually made of titanium dioxide has pure silver contacts and the surfaces of both rotor and stator are ground flat to eliminate air space variations with temperature.

Microcircuits and semiconductor devices

Failures of these devices in storage, or dormant applications, are the result of latent manufacturing defects that were not detected during device screening tests. These failure mechanisms, which are the same whether the device is operating or

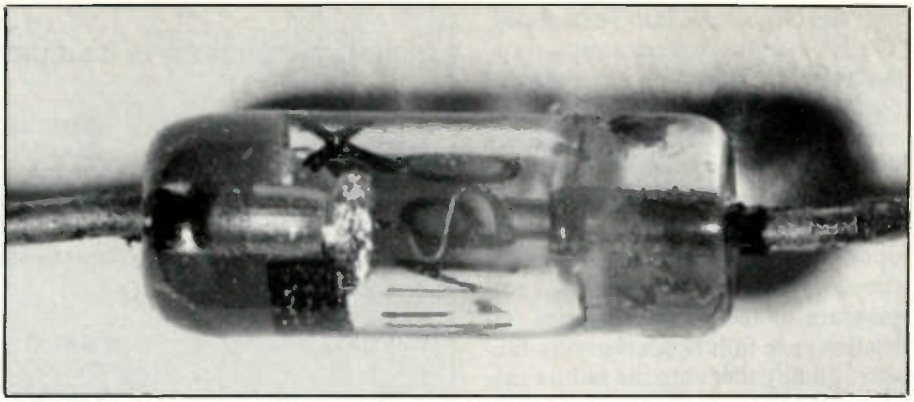

Figure 3. Spring loaded diodes can open circuit if the spring contact loses strength or if the contact slips off the die.

not, can be grouped into 3 categories. The first is failure mechanisms independent of application environment (oxide or diffusion defects). For these failure mechanisms the failure would only occur sooner if the device was operating. The second category is failure mechanisms dependent upon the application environment (bond or metalization defects). Temperature or mechanical stresses (vibration) are failure accelerating factors. Finally there are the failure mechanisms that are time and environment dependent (metal migration, corrosion, intermetallic compound formulations caused by dissimilar use). Operation of the device is an accelerating factor. Elevated temperature burn-in testing is a technique used to find failures that would ordinarily occur in the field.

TABLE 2
HYBRID MICROCIRCUITS - FAILURE ACCELERATING ENVIRONMENTS

MECHANICAL STRESS (THERMAL SHOCK, VIBRATION)	SUBSTRATE BONDING CRACKED/BROKEN SUBSTRATE FAULTY BONDS	OPEN CIRCUITS
HIGH TEMPERATURE	DAMAGED RESISTORS	OPEN OR OUT OF TOLERANCE
THERMAL CYCLING	CRACKED RESISTORS VARIOUS FILM DEFECTS EXCESS BONDING TIME THERMAL COEFFICIENT OF EXPANSION MISMATCH BETWEEN FILM AND SUBSTRATE	OPEN OR OUT OF TOLERANCE
HIGH VOLTAGE AND TEMPERATURE TEST	VARIOUS FILM DEFECTS EXCESS BONDING TIME THERMAL COEFFICIENT OF EXPANSION MISMATCH BETWEEN FILM AND SUBSTRATE	OUT OF TOLERANCE
THERMAL AND MECHANICAL STRESS	CRACKED DICE SHORTED WIRES	OPEN CIRCUITS SHORT CIRCUITS

Transformers

High storage temperature effects on transformers include reduced dielectric strength, open or short circuits (which can cause hot spots) and physical deformation (the potting can deteriorate). Humid or salt atmosphere effects include corrosion, fungus growth and short circuits.

Relays

The primary problem with relays is contact contamination and corrosion of metal parts in humid environments, along with fungus growth on the coils. Hermetically sealed relays, however, designed with materials to prevent outgassing, have a storage life in excess of 10 years. In dormant applications however, solid state relays are preferred. Relays for dry circuit applications (open circuit voltage less than 0.03V or less with current 200mA or less) should have gold plated contacts.

Switches

Just like relays, if switches are hermetically sealed and designed with stable materials, they should have a storage life in excess of 10 years. The major problem in storage, or dormant applications, is contamination of switch contacts. Storage at high temperature will increase the speed of corrosion of contacts and the insulation resistance between the switch and ground will decrease. Low temperature may allow some of the various switch materials to contract and they may crack or allow moisture or contaminants to enter the switch which can cause short circuits or voltage breakdown. High humidity also will result in increased corrosion and voltage breakdown.

Connectors

The same contact and corrosion problems associated with switches apply to connector contacts. Connectors should be stored in sealed moisture free containers with end caps placed over the connector contact mating end (if mated contacts are not being stored).

Batteries

Batteries come in two basic groups, rechargeable and non-rechargeable types. The charge retention of rechargeable (also referred to as secondary) batteries is less than other batteries, but when the charge of the secondary battery is maintained it will last longer than non-rechargeable types. Batteries deteriorate as a result of chemical actions during storage or dormancy. This self discharging can be kept to a minimum by storing them in a cool dry environment. Lithium and Magnesium types develop a protective coating on the active element during storage which extends shelf life. After storage however the voltage output of these batteries may be low until this film wears off.

Adhesives

Most adhesives have an expiration date stamped on the container, or on the tube crimp. In general, shelf life is about 1 year from shipment date.

Heat sink compound

If the container is unopened and rotated every 60 days the heat sink compound should last indefinitely. If it is left stationary for 12 months or more, the ingredients will separate and you will see an oil on the surface of the compound.

Conformal coating

Like adhesives, conformal coatings have an expiration date stamped on them. Shelf life is about 1 year from factory shipment date.

Solder flux

These compounds, made of paste fluxes and solder powders, should last 6 months if stored between 32°F and 44°F (0 and 7°C). At room temperature it can be stored for about two months after which it starts to thicken.

Mechanical assemblies

Mechanical assemblies in storage are susceptible to the degradations of their component parts, particularly corrosion and lubricant dry out. Their storage should be in sealed containers, with desiccant to absorb trapped moisture, and kept in a temperature controlled area. Any assembly stored for five years or more should be lubricated and have all the belts/tires replaced.

Cleaning solvent combinations

Tests done by the Jet Propulsion Lab in California have found that metals that come into contact with a combination of Trichlorethane (TCE) and water may later corrode. Trichlorethane has a tendency to decompose, producing Hydrogen Chloride (HCl) as a product of the decomposition. To prevent the decomposition, chemical additives are used to render the TCE stable for use as a cleaning solvent. One of these inhibitors is 1,4 Dioxane which is readily soluble in water. If TCE and water are mixed the Dioxane will dissolve in the water leaving the TCE to decompose. The Hydrogen Chloride from the TCE decomposition will dissolve into the water which will produce Hydrochloric Acid which will cause metal corrosion.

Static control materials

Topical antistats, such as those which may be used to coat some plastic IC DIP shipping tubes, include detergent substances which wet the surface being treated. These coatings depend upon their moisture content and work most effectively at high humidities. These coatings do wear out and treated surfaces must be checked periodically with a static detector. Some pink poly bags also lose their effectiveness and should be checked periodically. Treated IC DIP tubes should be retreated after use as the IC leads can scrape away the coating as they slide out of the tube.

Further reading

The information contained in this article came from many sources, including discussions with manufacturers, data sheets and military specifications. One report however, "Reliability/Maintainability/Testability Design for Dormancy," should be mentioned. This report was prepared by Lockheed Electronics for the Rome Air Development Center (report RADC-TR-88-110, May 1988) and is available for a fee from the Defense Technical Information Center (document #AD-A202-704). ■

Glossary

If there are words in this article that you are unfamiliar with, this definition listing may help.

Binder - A composition that acts as an adhesive and when applied to parts will solidify and hold them in place. For resistors the binder holds the resistor materials together.

Deforms ("oxide film deforms") - Refers to the changing back of the electrical characteristics that were modified by the application of electrical energy.

Derating - The intentional reduction of stresses (voltage, current, power etc.) on a part to reduce the occurrence of stress related failures.

Die separation (for microcircuits) - Refers to the separation of the actual microcircuit chip from inside the package.

Dielectric - An insulating or nonconducting material that maintains an electric field (charge) with little or no energy from outside sources. This material is between the plates of the capacitor.

Dielectric strength - The potential at which electric failure or breakdown occurs.

Difussion ("oxide diffusion defects") - Refers to defects in the oxide coating layer.

Dissipation factor - Ratio of the effective series resistance to the reactance of a capacitor, measured as a percentage. The reactance of a capacitor is the opposition to the flow of alternating current. Capacitive reactance (Xc) is the opposition offered by capacitors and is measured in ohms.

Etching (for microcircuits) - Refers to the etching of the silicon layer in the photolithography process of designing and laying out of the IC.

Fired ("Pure silver fired on . . .") - The deposited silver is heated in a kiln or oven.

Metalization (for microcircuits) - The deposited thin metallic coating layer.

Passivation (for microcircuits) - The process in which an insulating dielectric layer is formed over the surface of the die. Passivation is normally achieved by thermal oxidation of the silicon and a thin layer of silicon dioxide is obtained in this manner. Other passivation dielectric coatings may also be applied such as silicon glass.

Phenolic - A type of plastic.

Potting (transformer potting can deteriorate) - Refers to the encapsulating material of the transformer.

Rotor (in variable capacitors) - The rotating or moving part of the capacitor element.

Sintered slug - Sintering refers to the process by which the material, or slug, is made.

Slice preparation (for microcircuits) - This refers to the slicing of the semiconductor crystal material into wafers.

Stator (in variable capacitors) - The stationary part of the capacitor element.

Substrate (for microcircuits) - The supporting material upon which the microcircuit (IC) is fabricated on or in hybrids. The part to which the IC (etc.) is attached.

Temperature coefficient - The change in capacitance per degree change in temperature. It can be either positive, negative or zero and is usually expressed in parts per million per degree C (PPM/°C).

Wire bonds (for microcircuits) - Connections between wires, that are connected to the lead frame, and the microcircuit chip itself.


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Replacement parts/servicing information sourcebook

By the ES&T staff

Of the most difficult problems faced by consumer electronics servicing technicians, the twin problems of locating servicing information and obtaining replacement parts are among the toughest. These problems are frequently compounded by the fact that many products are private labeled, and without some kind of key it's impossible to determine who manufactured them. In the December 1989 issue, we published a replacement parts and servicing information sourcebook that provided several keys to determining who made a given brand of product, and where to go to obtain replacement parts. That article was so well received that it is being reprised here for the sake of those who missed it the first time around, with some additions and changes.

Breaking the codes

For example, did you know that if you can find a UL manufacturer's code number or an FCC ID number on a TV or VCR, that you can use that number to identify the manufacturer? Did you know that if you have the right VCR cross reference, you might be able to use a VCR servicing manual that you already have from a well-known manufacturer to troubleshoot a VCR from a manufacturer you've never heard of, and you might even have some of the needed replacement components in stock and might be able to identify them? Here are the facts.

Finding replacement parts

Here's a list of references that are useful in tracking down the manufacturer, or parts distributors. We think that every electronics servicing facility should have them:

Consumer Electronics Replacement Parts Source Book
Consumer Electronics Group,
Electronic Industries Association
PO Box 19100
Washington, DC 20036
(Include $1.00 for postage and handling)

Electronic Industry Telephone Directory (Or some equivalent)
Harris Publishing Company
2057-2 Aurora Rd.
Twinsburg, OH 44087-1999
(This will cost around $50.00)

Consumer Electronics Show (CES) Official Directory
Consumer Electronics Group
Electronic Industries Association
2001 Pennsylvania Ave, N.W.
Washington, DC 20006-1813

The CES directory includes a Brand Name section, which lists the booth numbers where all of the brand names will be exhibited at the show. The booth number listings then show which companies will be in which booths.

The best way to get a copy of this directory is to attend the Consumer Electronics Show, either in January in Las Vegas, or in June in Chicago. It comes with the price of attendance. If you can't get to the show, limited numbers of copies of the directory may be available from the above address. You might want to write to them and find out if they are available and at what price. The cover of the guide says "$25.00 Value."

The limited quantities of the CES showguide will be available at the reduced price to **ES&T** readers who send in the coupon on this page. Quantities are limited, but the EIA/CEG will fill as many orders as possible.

As an example of the information that can be garnered from this guide, one of our readers wrote in asking how to find the manufacturer of a Conic TV. A look through the Brand Name section of the guide showed that the company at booth 601 was exhibiting that brand name. Then, looking through the numerical listing of booth numbers in another section of the guide showed that the company exhibiting at booth 601 is Cony Electronics, Inc. The listing revealed the following detailed information:

Cony Electronics, Inc.
222 S. Riverside Plaza, Ste 1550
Chicago, IL 60606
(312)-207-0017
Television and Audio Products
M. S. Shu, President; Keynes Lau, Executive Vice President
Brands: CONTEC, CONIC

You won't always find this kind of information in the guide, but being

Please send me a copy of the Consumer Electronics Show Official Directory, as mentioned in **ES&T**. Enclosed is a check for $12, payable to the Consumer Electronics Show. (For **ES&T** readers only. Regular price is $25.)

Name ______________________________

Address ______________________________

City ______________ State ____________ Zip ____________

Mail to: CES, Attn. Patty Kain,
2001 Pennsylvania Ave, N.W.
Washington, DC 20006-1813

FCC ID numbers

Manufacturer	FCC ID Number
Akai	ASH
Fisher	AFA
GE	AJU
Goldstar	BEJ
Hitachi	ABL
Lloyds	ADT
Magnavox	BOU
Mitsubishi	BGB
NEC	A3D
Panasonic	ACJ
RCA	AHA
Samsung	A3L
Sharp	ATA
Shintom	E0Z
Sony	AK8
Sylvania	AIX
Symphonic	ADT
TMK	A7R
Toshiba	AGI
Zenith	ASI

Figure 1. Every VCR, personal computer, cordless telephone and microwave oven must carry an FCC ID number. The first three characters of that ID uniquely identify the manufacturer of the product. This is a listing of FCC ID number vs manufacturer.

UL numbers for VCR manufacturers (unofficial)

UL number	Manufacturer	Brand names
16M4	Samsung	Supra, Multitech, Unitech, Tote Vision, Cybrex, GE, RCA
174Y	Toshiba	Sears
238Z	Hitachi	RCA, GE, JC Penney, Pentax
333Z	Symphonic	Teac, KTO, Realistic, Multitech, Funai, Porta Video, Dynatech, TMK
403Y	Fisher/Sanyo	Realistic, Sears
439F	JVC	Zenith, Kenwood, Sansui
44L6	TMK	Emerson, Lloyds, Brooksonic
504F	Sharp	Wards, KMC
51K8	Porta Video	
536Y	Mitsubishi	Emerson, Video Concepts, MGA
570F	Sony	Zenith
679F	Panasonic	RCA, GE, Magnavox, Quasar, Canon Philco
781Y	NEC	Dumont, Video Concepts, Vector, Sears
86B0	Goldstar	Realistic, JC Penney, Tote Vision, Shinton, Sears, Memorex

Figure 2. The UL listing number on a consumer electronics product identifies the manufacturer who made it. Here's a partial listing of UL numbers vs. manufacturer.

The FCC public-access information system

Every VCR, personal computer, microwave oven and cordless phone sold in the United States must bear an FCC identification number because they are considered to be potential generators of radio-frequency interference. This number identifies which company manufactured the unit. If you have one of these products in your shop for service and can't identify the manufacturer, you can contact the FCC through its public-access system and find out.

There are two ways to get this information: via voice telephone or via computer and modem by contacting the public-access bulletin board. The FCC prefers to have people use direct computer-to-computer contact.

To contact the FCC bulletin board, you must have a computer and a modem capable of 300 baud or 1200 baud. The number to call, in Maryland (just outside of Washington, D.C.), is (301)-725-1072. This is a toll call. Dialing this number at any time should get you in direct contact with the bulletin board.

Once you have made contact, the computer screen will tell you how much time you have and provide you with a menu of items to choose from. When ES&T dialed up the bulletin board on October 18, 1990, once we accessed the bulletin board the portion of the bulletin board that contained the FCC ID number to manufacturer cross reference was:

1. ACCESS EQUIPMENT AUTHORIZATION DATABASE. To get to it, it was necessary only to key in the number 1 and press ENTER.

After pressing 1 and ENTER, the bulletin board presented three options. The one to choose in this case was:

2. GRANTEE NAME & ADDRESS BY CODE, and again ENTER. Then the bulletin board asked for a three character code. That's the first three characters of the FCC ID number. Entering that and pressing ENTER caused the bulletin board to respond with the name and address of the manufacturer of the product in question.

The other method of obtaining this information is to call 301-725-1585, Monday through Thursday between 2:00 and 4:30 p.m. and ask to be connected to the status desk. The individual who answers will relay your question to the bulletin board via a computer terminal and will then relay the information it provides to you.

Obviously, if you have a computer and a modem, it makes far more sense to contact the computer directly. You'll cut out the middle man and, of course, you can contact the computer any time.

Information Exchange

Akai
Servicing literature and replacement parts for Akai products are available from:

Mitsubishi Electric Sales America
National Service Department
5757 Plaza Drive
P.O. Box 6007
Cypress, CA 90630-0007
800-553-7278
714-220-2500

BSR parts
Service, repair and parts for BSR equipment is available from:

Carillon Technology
707 E. Evelyn Ave.
Sunnyvale, CA 94086
408-720-9800

Bohsei parts
Available from:

Audio Parts Co.
1070 S. Orange Drive
Los Angeles, CA 90019
213-933-2141

Conic, Contec
Manufactured by:

Cony Electronics
222 S. Riverside Plaza, Suite 1550
Chicago, IL 60606
312-207-0017

The Conic model T-7711A is the same as the Radio Shack unit, catalog 16-234, according to one reader.

Dokorder
Sources for belts for the model 7140 Dokorder reel-to-reel tape recorder are available from the following manufacturers:

Prime Electronics
P.O. Box 28
Whitewater, WI 53190
800-558-9572
Fax: 414-473-4727

Indiana Wholesale Electronics
514 Third Street
Aurora, IN 47001
812-926-4344

Emerson VCR parts
The STK5486 replacement IC voltage regulator chip for an Emerson model VCS966A VCR is listed in the MCM Electronics catalog:

MCM
650 Congress Park Drive
Centerville OH 45459
800-543-4330

Other readers have indicated that Emerson parts are available from the following companies:

Electronics Warehouse
1910 Coney Island Ave.
Brooklyn, NY 11230
800-221-0424
Fax: 718-375-2796

Fox International
752 S. Sherman
Richardson, TX 75081
800-331-2501

The company address is:

Emerson Radio Corporation
One Emerson Lane
N. Bergen, NJ 07047
201-854-4800

Fisher
The Sanyo Fisher Service Corporation strongly recommends ordering by fax, telex or mail.

Western Region:
1200 W. Artesia Blvd.
Compton, CA 90224
213-605-6742
Fax: 213-604-0925

Mid-West Region:
600 Supreme Drive
Bensenville, IL 60106
312-350-1505
Fax: 312-350-1621

Eastern Region:
210 Riser Road
Little Ferry, NJ 07643
201-641-3000
Fax: 201-641-1791

Southern Region:
1790 Corporate Drive #340
Norcross, GA 30093
404-925-8900
Fax: 404-925-9308

Goldstar
The company address is:

Goldstar Electronics International
1050 Wall St. West
Lyndhurst, NJ 07071
800-255-2550

Grundig stereo equipment
Servicing manuals and replacement parts for some Grundig units are available from:

Act Electronics
Parts Department
2345 E. Anaheim St.
Long Beach, CA 90804
214-433-0475

Hitachi
Hitachi doesn't stock manuals for products more than 10 years old. However, the company can photocopy schematics for these products for a nominal fee.

Hitachi Service Company
401 W. Artesia Blvd.
Compton, CA 90220
213-357-8383

Figure 3. Sometimes it's difficult to find parts or servicing information for a product, even if you know who the manufacturer is. This listing will provide you with some parts sources for some products.

able to find a few elusive manufacturers, thus saving hours of frustration and phone calls or letters to try to locate the manufacturer, might just be worth the price of the book.

A VCR model number and parts reference

Another invaluable reference is published by the International Society of Certified Electronics Technicians (ISCET): *A VCR Model Number and Parts Cross Reference.* This reference is available in two forms: a set of shrink-wrapped loose leaf sheets for a cost of $35.00 plus $3.00 for shipping, and a floppy disk at a cost of $99.00. They are also available in combination; both paper and disk for $125.00. To obtain one, you may send a check or money order for the correct amount to ISCET, 2708 W. Berry Street, Ft. Worth, TX 76109. ISCET will also accept telephone MasterCard or Visa orders at (817) 921-9101.

This is a two-part reference that will help any servicing organization that services VCRs to cross reference among different brands made by the same manufacturer. Part 1 of this reference will allow the user to determine when he has a product in for servicing, if it's possible that it's identical, or almost, to a product for which he already has a servicing manual. Part 2 of the reference cross references parts, so that if you can't find a particular part number for a product you are servicing, you may find that you have it on hand under a different part number for another manufacturer's product.

The ISCET cross reference was updated in February of this year, and

Kawasho
The company address is:
Kawasho International
1500 Clinton St., Bldg. 747
Buffalo, NY 14206
800-922-1722
716-821-0747

Kawsho flybacks are also available from:
Electo Dynamics
898 Route 106
E. Norwich, NY 11732
800-426-6423

Lloyds
The company address is:
Lloyds Electronics
180 Raritan Center Parkway
Edison, NJ 08818
210-225-2030

Lloyds model L838 series 821A VCR parts and Magnasonic TV parts are also available from:
M.L. Corporation
1959 Leslie St.
Donmills, Ont.
Canada, M3B 2M3

MultiTech
Parts and servicing information for MultiTech, DynaTech, Spectrum, HiTech are available from Trans-World Electronics:
Trans-World Electronics
15304 E. Valley Blvd.
City of Industry, CA 91748
800-822-1236

The MultiTech MV-089 is identical to the Symphonic model 5200:
Symphonic Corporation
100 North St.
Teterboro, NJ 07608
800-242-7158

Phone-Mate
The company address is:
Phone-Mate
Customer Service
215 W. Old Country Road
Hicksville, NY 11801

Parts, schematics, etc., for Phone-Mate answering machines can be ordered from Audio Video Parts:
Audio Video Parts
P.O. Box 19670
1071 S. LaBrea Ave.
Los Angeles, CA 90019
213-933-8141

Samsung
Samsung and Astra brand products are manufactured by Samsung:
Samsung Electronics
18600 Broadwick St.
Rancho Dominguez, CA 90220
800-634-8276

Non-authorized servicers:
Fox International Lts.
23600 Aurora Road
Bedford Heights, OH 44146
800-321-6993

Vector Research
Vector Research is an audio company that sold specially designed VCRs manufactured in Japan. The company no longer offers VCRs for sale, but it will provide information for anyone needing to service one of its products.
Vector Research Service Department:
1230 Calle Suerte
Camarillo, CA 93010
805-987-1312

Video Concepts
Mitsubishi will give its equivalent number for the Video Concepts HT2000.
Mitsubishi Electric Sales America
Attn: Service Parts Dept.

now includes over 250 additional model cross references and over 100 additional parts cross references.

Identifying a manufacturer from the FCC ID number

Almost all consumer-electronics products, at least any that have to be plugged in to the power outlet or that might generate electromagnetic interference, carry clues as to who the manufacturer is. One of these numbers appears on every VCR and computer, and any other product that might generate electromagnetic interference. It's the FCC identification number. Armed with this number, a technician may call or write the FCC:

Federal Communications Commission
1919 M Street, NW
Washington, D.C. 20463,

Give the ID number and ask for the name and address of the manufacturer. A partial cross-reference list of manufacturer and model number vs FCC ID numbers is provided in Figure 1. Please note that this is not an officially prepared listing but one that was put together by one of our readers and so may contain errors. In spite of any errors that may be present, it should provide you with some useful information.

Identification using the UL manufacturer's code number

Another source of manufacturer identification information is the Underwriters Laboratories code number. The manufacturer of every product that is submitted to UL for certification is assigned a unique code number that identifies who the manufacturer is. Figure 2 is a partial list of UL numbers and the manufacturers they represent. Again, this listing is unofficial provided by a reader, and so may not be 100 percent correct. We're working on expanding both lists, and checking them for accuracy. For now we felt that this information, even though incomplete and needing verification was so vital to all readers that we'd get it into print as soon as possible.

Information exchange

Here at **ES&T** we are trying to gather as much information as we can to help our readers who are trying to find both servicing information and replacement parts for obscure (and not so obscure, sometimes) product brands. The strength of the magazine in finding this kind of information is the size of our readership, and the willingness of readers to share information with other readers. Figure 3 is a comprehensive list of all of the information we have unearthed to date via our information exchange program.

Our thanks to every one of our readers who have sent in information in response to questions from other readers. We feel that we're making some real headway in getting this problem of information sorted out, but we have a long way to go. Please keep the questions and answers coming.

Unless otherwise noted, the addresses and phone numbers are the best information we currently have on where to locate parts and servicing information for the listed manufacturers. If any of you try these addresses or phone numbers and come up with information to the contrary, please let us know.

Troubleshooting Start-up circuits

By Homer Davidson

The key task in servicing start-up and shut-down circuits is to determine if a defect that is causing a dead set is either a start-up or a shut-down defect, or both. Since start-up and shut-down symptoms may occur together or separately, they are sometimes difficult to isolate. Often, the start-up circuits will not allow the chassis to fire up or continue to operate, while shut-down problems may occur after the chassis is functioning. Remember, a shut-down condition or overloaded circuit may prevent the TV chassis from starting up.

Most TV start-up problems originate in the low-voltage power supply or horizontal circuits (Figure 1). Shut-down problems may occur in just about any circuit, but most are found in the horizontal circuits. Start-up problems that are the result of poor transformer connections, startup transformers, open transformer windings, or just about any component in the low-voltage power supply are usually simple to track down. Startup troubles in horizontal oscillator, horizontal output, power regulators, horizontal driver transformer and flyback circuits may prove more difficult to diagnose. Of course, the most difficult start-up problems are the intermittent start-up, intermittent start-up and shut-down, and no start-up in switched mode power supplies.

RCA CTC 92—No start-up

Several RCA CTC 92A TVs that were brought in to my service center with start-up circuits that would not function required replacement of the start up transformer, T201 (Figure 2). In one particular CTC 92A chassis that I worked on, the set would sometimes come on and operate fine, but the next time it was turned on it would not start up. Sometimes the set would run all day long and not shut down, although it might or might not start up in the first place. Replacing the intermittent start-up transformer (142712) solved the intermittent start-up condition.

Montgomery Wards CGY-16215A Dead—No start-up

Although this set would not start up, the components in the horizontal output circuits that were found to be defective may have been damaged as the result of a defect that originally caused chassis shutdown. Here the primary winding of the driver transformer (T440) was open, and the horizontal driver transistor was leaky (Figure 3). No doubt Q400 became shorted which in turn burned out the driver transformer and opened up resistor R444 (1.3K). All three components were replaced before high voltage was restored.

RCA CTC 108 intermittent start-up and shut-down

Here's a cause of intermittent start-up and shut-down problems that we tracked down in an RCA CTC108 chassis. The same problem was subsequently found in several CTC 107 and CTC 110 chassis with similar problems. The horizontal driver transformer between Q411 and Q412 had some intermittent connections. Resoldering all four connections of the transformer solved this problem (Figure 4). Replace the transformer if the winding is open.

RCA CTC 117A—Open R426—No start-up

In this set, raw +150V is applied to R426 (5.6K) at all times. When the horizontal drive signal is absent at pin 16 of deflection IC U401, the horizontal drive transistor (Q401) may pull extra current which will cause it to run warm. This makes R426 run quite warm and may cause it to be damaged. R426 is physically located

Davidson is a TV servicing consultant for ES&T.

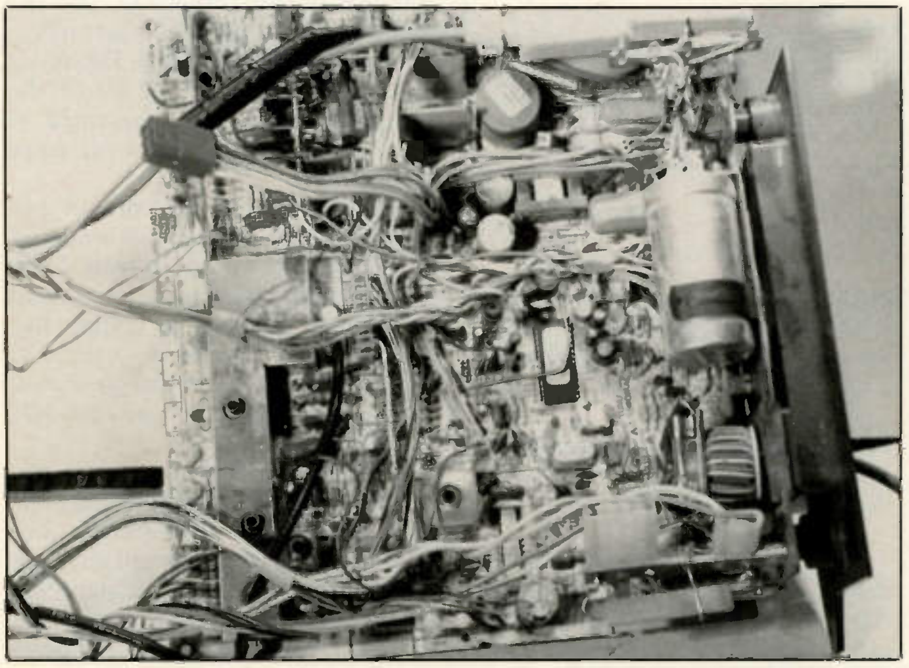


Figure 1. Most start-up and shut-down problems are caused by defects in the low-voltage power supply and horizontal circuits (RCA CTC 93).

just in front of the horizontal flyback transformer (Figure 5). The only symptom may be a tic-tic noise from the flyback transformer with no start-up.

If R426 is burned open, the chassis will not start up. When R426 increases in value, intermittent start-up is likely (Figure 6). Sometimes if there has been only a slight change in R426 the set will work fine when the ac power is close to the nominal 120Vac, but will fail to start in the event of low power line voltage. Slightly higher than normal power line voltage will probably have no effect. In the latest CTC 117 chassis, R426 has been changed to a 9.1KΩ, 3W resistor to alleviate this problem.

RCA CTC 107C—No start-up

Many no-start-up symptoms are caused by defective components within the horizontal output circuits (Figure 7). When a set fails to start up, check for a leaky or shorted horizontal output transistor or an open output transistor. In this CTC 107C chassis, the flyback and filter capacitor make it difficult to get to the output transistor. In order to get to the base and emitter terminals you may have to loosen up the output transistor.

Besides checking the output transistor, test the damper diode for leakage. Open or shorted capacitors in the output transistor collector circuits may prevent start-up or cause excessive high voltage. In one RCA CTC 107C chassis, C434 was found to be leaky, preventing start-up of the horizontal output circuits (Figure 8). Replace these capacitors with exact replacements.

RCA CTC 107—No oscillator start-up

Most TV chassis will not start up and continue to operate in the absence of a waveform from the horizontal oscillator or IC deflection countdown circuits. We encountered an unusual no startup dead chassis in an RCA CTC 107 chassis; caused by a defective regulator oscillator circuit. If you suspect a similar fault, check regulator oscillator Q103 and Q104 for open or leaky conditions. In several sets, R118 (330K) resistor

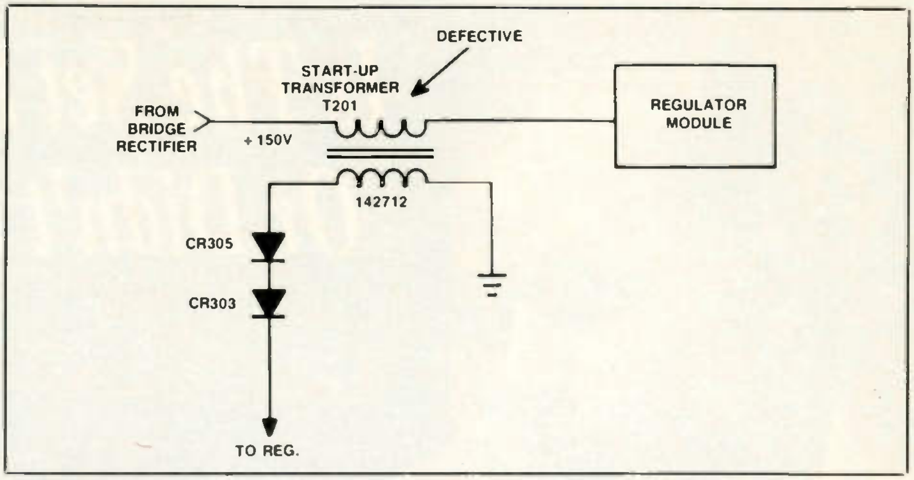


Figure 2. Failure to start-up in an RCA CTC 92 chassis resulted from a defective start-up transformer (T201).

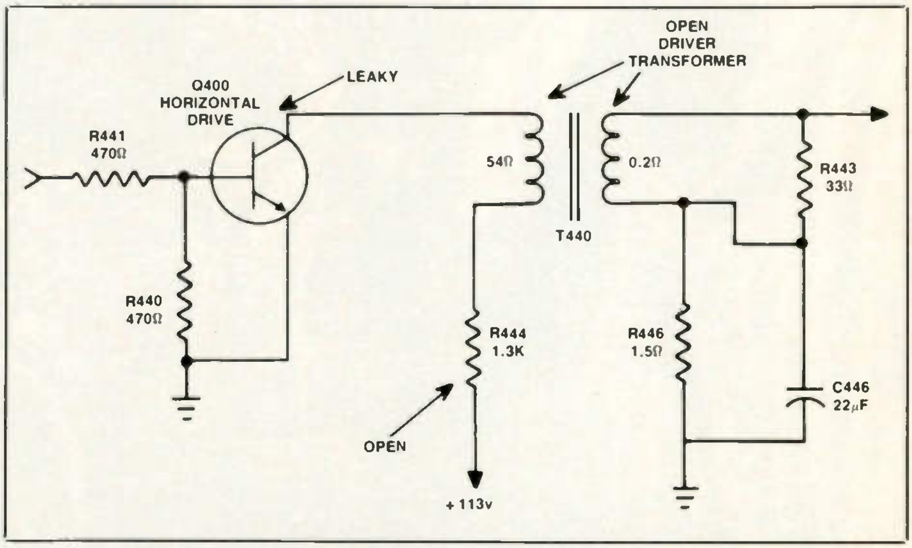


Figure 3. Check the driver transistor and transformer (T440) in the Montgomery-Ward CGY-16215A model when the symptom is failure to start up, or shut down.

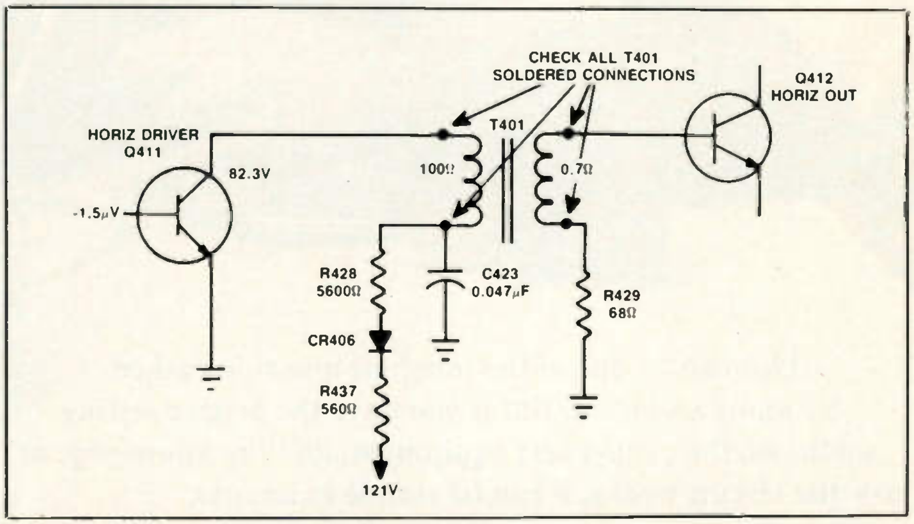
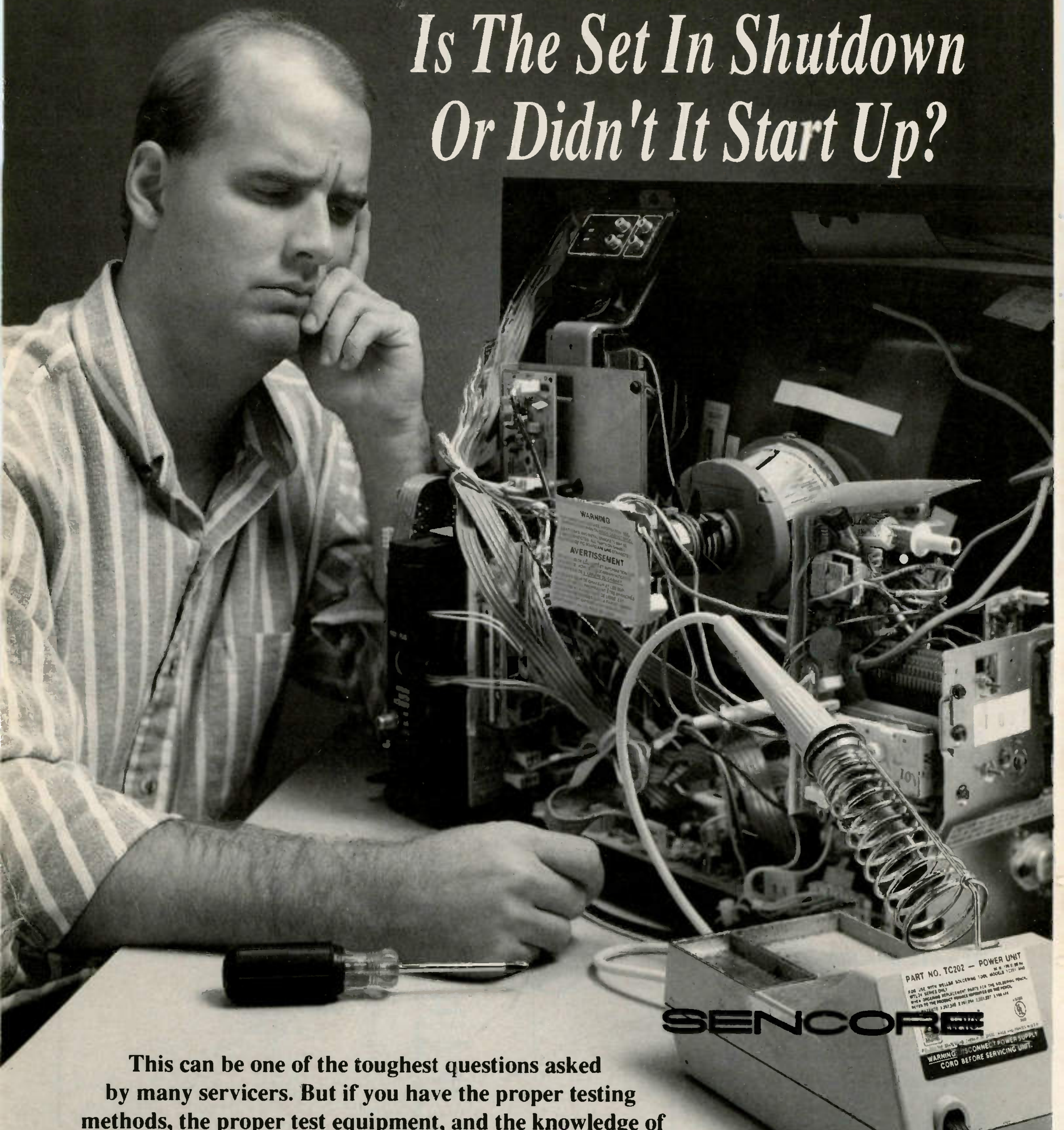


Figure 4. Resoldering the horizontal driver transformer connections solved the intermittent start-up problem in one RCA CTC 108 chassis.

Before You Troubleshoot—You Must First Decide

Is The Set In Shutdown Or Didn't It Start Up?



SENCORE

This can be one of the toughest questions asked by many servicers. But if you have the proper testing methods, the proper test equipment, and the knowledge of how the circuit works, it can be simple to answer.

Return This Card For FREE Startup/Shutdown Information, Or Call Toll-Free 1-800-SENCORE (736-2673)

Circle (61) on Reply Card

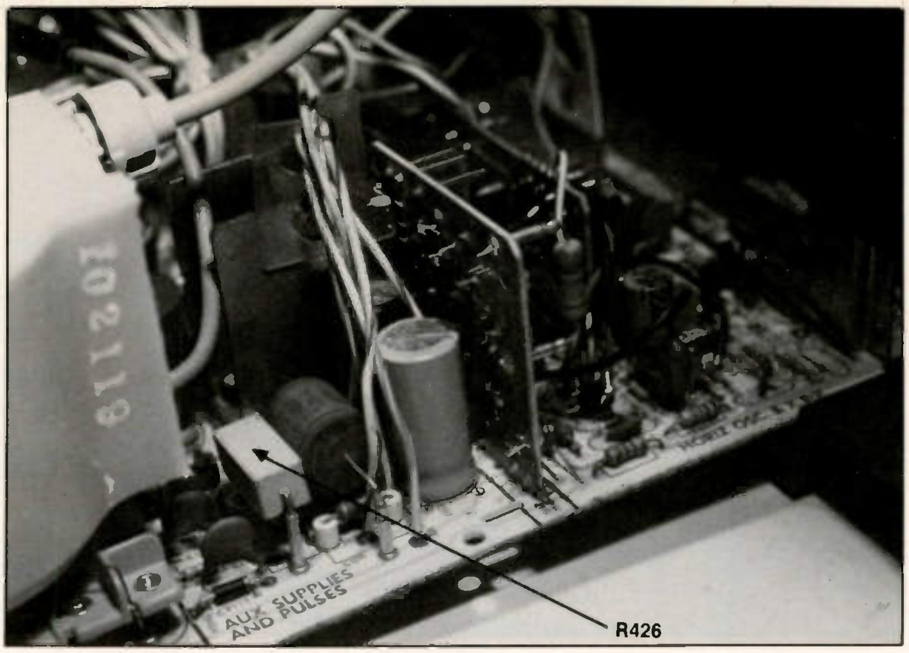


Figure 5. R426 in the RCA CTC 117A chassis may become warm, overheat, and produce no-start-up or intermittent start-up conditions.

was found open (Figure 9). Do not overlook the possibility that R116, R117 and R118 in the regulator circuits could be faulty. Remove one end of each resistor for accurate measurement of resistor.

Sylvania C9 switched-mode power supply

Switched-mode and scan-derived power supplies may be more difficult to service and therefore are likely to take more time. Failure of a switched-mode power supply to start up may be the result of one of two general conditions: 1. a defective component in the supply, or 2. a fault in a circuit that is fed by the switched-mode power supply that is causing an overload to the supply. In the Sylvania C9 chassis, the switched-mode power supply develops the +13V, +24V, +24/27V and 130V sources.

Let's examine the case where the symptom is a clicking, or chassis start-up sound when the chassis is first turned on, but no picture or sound appears: the chassis remains in the no start-up or shut-down mode and there is no voltage at any of the power supply outputs. As a first step, check for 155V dc source at the collector terminal of the switched-mode regulator Q400. If you don't find any voltage at TP22, suspect an open fuse or leaky bridge rectifier. This 155V is required to provide forward bias voltage at Q400.

Measurements of critical waveforms and voltages within the start-up and standby circuits may help you determine if either the start-up or standby and overloaded circuits in the power sources are defective. Remove the horizontal output transistor, or R513, to defeat the horizontal output and high-voltage circuits. Place a 60W or 75W bulb as load resistor across the 130V source. If the switched mode power supply voltage comes up, suspect overloading in the circuits that are supplied by the output voltages. If the set still doesn't start up, this indicates problems within the switched-mode power supply or standby circuits.

C9—No start up

Before attaching any test instruments to the C9 chassis, make sure it's plugged in to an isolation transformer. This set employs a full-wave bridge rectifier. If you connect it to a piece of test equipment and connect their grounds in common without using an isolation transformer, you will short out and destroy at least one power supply diode, and possibly several more components. In fact, because large numbers of today's sets employ bridge rectifier circuits it's a sensible precaution to always use an isolation transformer rather than make a mistake.

Remember, all voltages for the C9 chassis are developed in the switched-mode power supply except the 200V source for horizontal scan circuits. There are two different ground systems in this chassis.

Connect the test instrument ground to the IF shield, and hot ac ground for chassis signal ground. The hot ac ground is located on the edge of the power supply section. The chassis ground is located in the signal section. Do not connect for common ground at the transistor heat sinks. TP19 is a ground terminal located at the negative end of the bridge rectifier.

When the fuse (F400) is blown, suspect a defective switched mode regulator transistor (Q400) or bridge diode (Figure 10). Sometimes a leaky Q400 transistor may cause one or

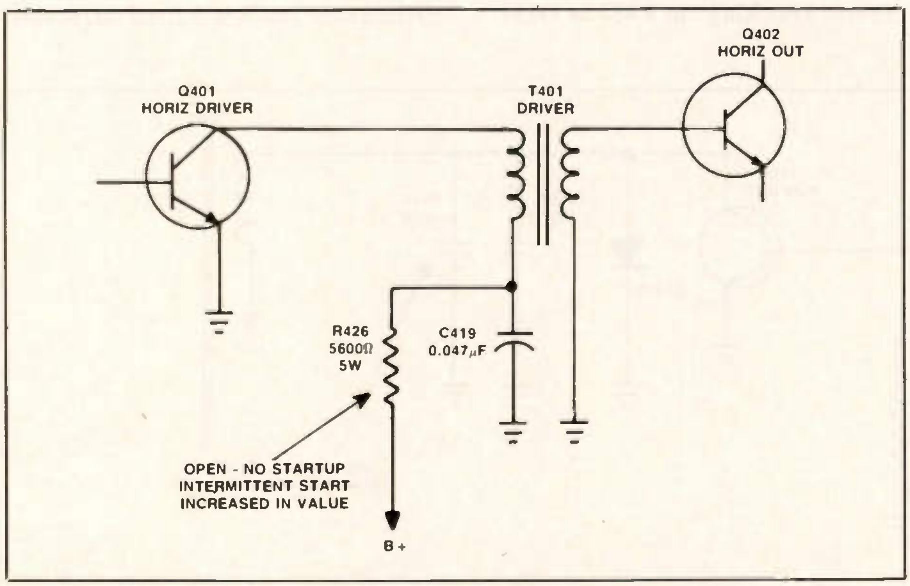


Figure 6. When R426 increases in resistance, the chassis may become intermittent in the RCA CTC 117 chassis.

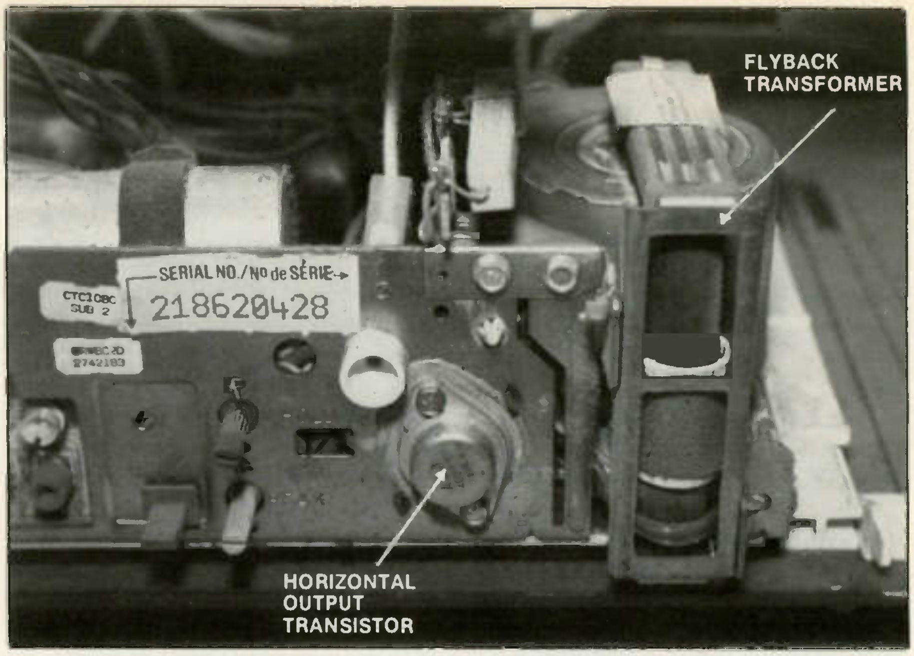


Figure 7. The horizontal output transistor and associated components may cause no start-up or chassis shut-down problems.

more of the bridge diodes to open. The + 155V developed by the bridge rectifier and filter capacitor C403 (330μF) provides voltage to the primary winding of T401 and switched-mode regulator (Q400).

A quick resistance test between collector (case) of Q400 and ground (TP19) may indicate a short between collector and emitter terminals. Check both the bridge rectifier and Q400 when the fuse continues to blow open. The + 155V source may be measured at the collector (case) of Q400 or at TP22. Use TP19 as ground connection for the ac power source and primary circuits of T401.

Repeated damage to Q400—C9 chassis

Always check the duty cycle control transistors (Q402 and Q403) when the switched-mode regulator transistor (Q400) keeps shorting out. It's wise to make a quick leakage and open tests of Q402 and Q403 when you find that Q400 is leaky. If either of these transistors is open or leaky, a replacement regulator will be damaged right away. Make sure that the ac cord is disconnected while taking resistance and in-circuit transistor tests.

Besides duty cycle control transistor tests, check resistor R430 and R432. Likewise, check corresponding diodes D421 and D425 (Figure 11). The resistors may be burned and the diodes may be leaky or open. When either resistor or diode becomes leaky or open, the chassis will remain dead.

Do not overlook an open fusible resistor in the secondary winding of T401 (R434). This 1Ω resistor connects ac voltage to D434, providing a 24/27Vdc voltage source for standby and optoisolator (IC104). This dc voltage source provides operation IC104, feedback loop to Q406 and Q407.

If R434 is found open or keeps blowing, suspect overload conditions in the 24/27V voltage source. Leave R434 open and inject a 24Vdc source and troubleshoot these circuits before servicing the startup switched-mode circuits. Do not overlook the possibility that a defective circuit in the vertical or sound circuits is overloading this supply source knocking out R434 or D434.

Isolation transformer C9 damage

One of the technicians in our shop connected the scope and ac-operated digital VOM to a dead C9 chassis without thinking of the consequences of not using an isolation transformer. Besides the original defective component, Q400, Q402, Q403, D421, D425, R422 and R421 were damaged. After replacing all these components, the chassis remained dead.

The chassis appeared to come up and shut down at once. Sometimes if the scope is used in the control circuit to monitor the waveforms, you can tell if these circuits are performing. When the chassis was fired up, sever-

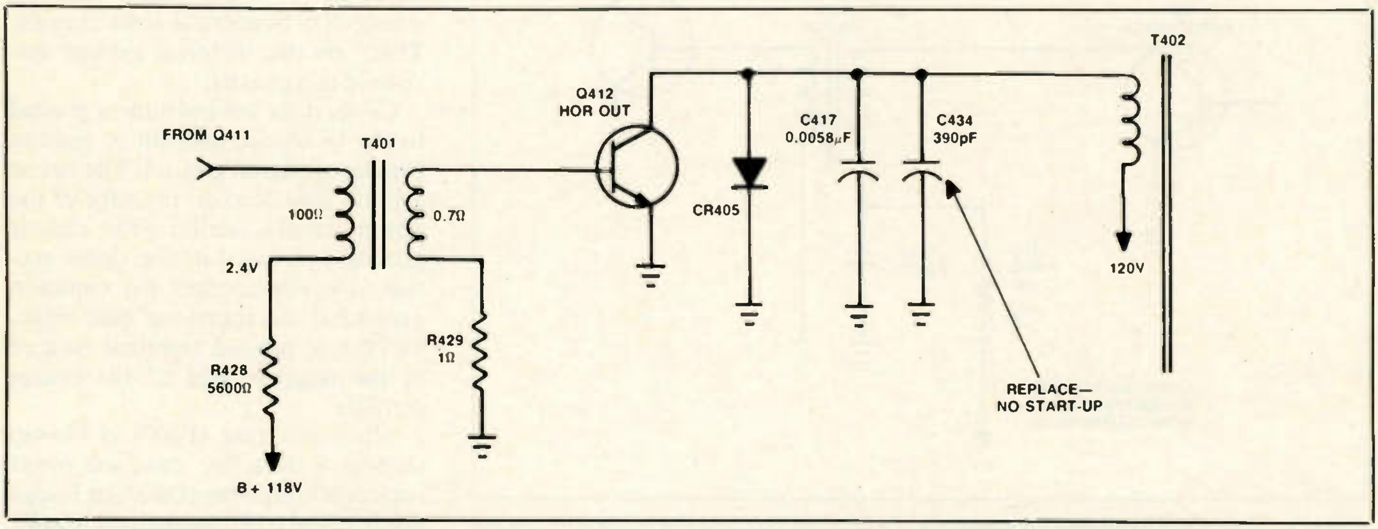


Figure 8. A leaky ceramic capacitor (C434) produced the no start-up operation in the RCA CTC 107C chassis.

al waveform tests were normal for a second, then collapsed. Perhaps one of the connecting dc sources was overloaded. Checking for overloaded circuits and making a visual inspection of the chassis revealed the ground pc wiring was burned off in three different places. Replacing the pc wiring with hookup wire and replacing all those parts solved the unfortunate accident of not using an isolation transformer.

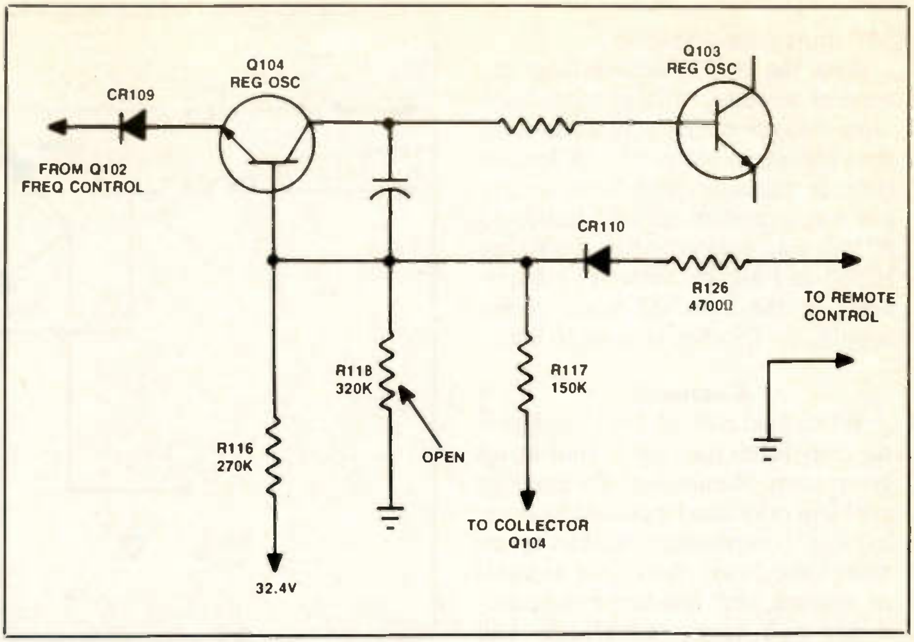


Figure 9. R118 (330K) resistor in the regulator oscillator (Q103) transistor case circuit prevented the chassis from starting up in the RCA CTC 107 chassis.

Lightning damage—C9 chassis

A Sylvania C9 chassis that we picked up for repair had been damaged by lightning. Because many appliances in the home were damaged, we thought that the TV chassis might be damaged beyond repair. Visual inspection of the chassis indicated that the low-voltage power supply had a few blown apart components and some scorched pc wiring.

We immediately replaced the fuse, bridge rectifier and Q400 regulator, and bridged several sections of pc wiring with hookup wire. Q402 and Q403 were also replaced. Further inspection led us to replace D421, D425, R432 and R430 as well. When we turned on the set it started up, then immediately shut down. We measured a low voltage of + 155V at Q400.

Closer inspection indicated that R434 (1Ω) resistor was open. D434 tested normal. After replacing R434, the chassis was fired up with the same results. We tried injecting a 24Vdc voltage source at TP10. The dc source dipped to 11V. No doubt one of the components connected to this

24V source must be leaky.

Since the 24/27V source feeds the vertical circuits, voltage and resistance measurements were made upon the vertical output IC580. A low resistance measurement from supply pin 8 to common ground indicated IC580 was leaky. After replacing IC580 and all the defective components in the switched-mode power supply, the C9 chassis came to life.

Comments

When a set is dead, try to isolate if the chassis has start-up or shut-down symp toms. Remember, the start-up problem may also be caused by overloading components producing instant shut-down. A careful analysis of voltage and resistance measurements and scope waveforms will solve most start-up problems.

Don't overlook the possibility that a defective component connected to one of the voltage sources is preventing chassis start-up. Make a habit of checking all critical parts in the switched-mode power supply and standby circuits. Inject an outside voltage source to help locate a defective overloading component. Universal transistors and IC components can be substituted in most start-up circuits when the originals are not available. Replace all defective start-up and switched-mode transformers with original part numbers. ■

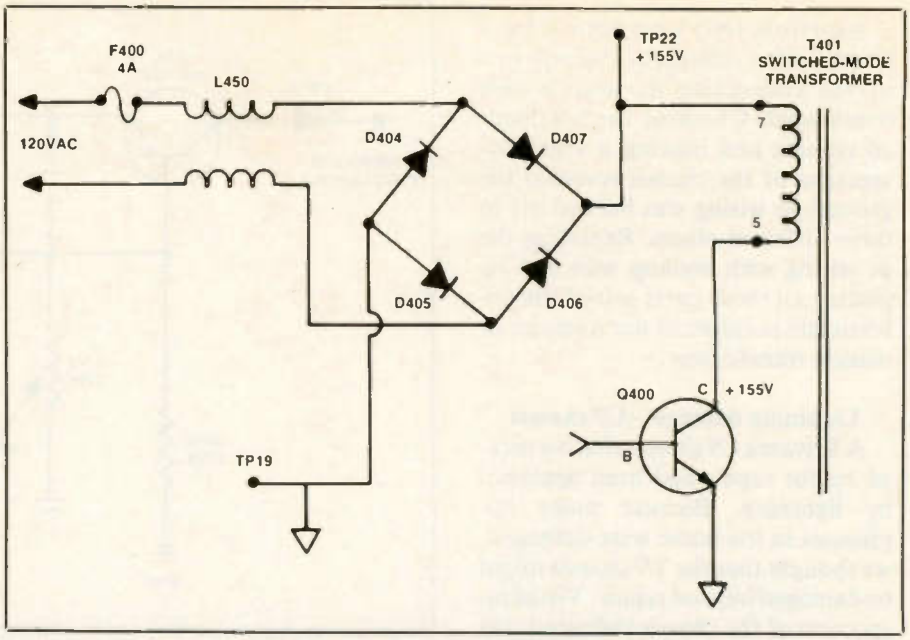


Figure 10. Suspect a leaky regulator transistor (Q400) in the switched-mode power supply of a Sylvania C9 chassis for no start-up and blown fuse (F400).

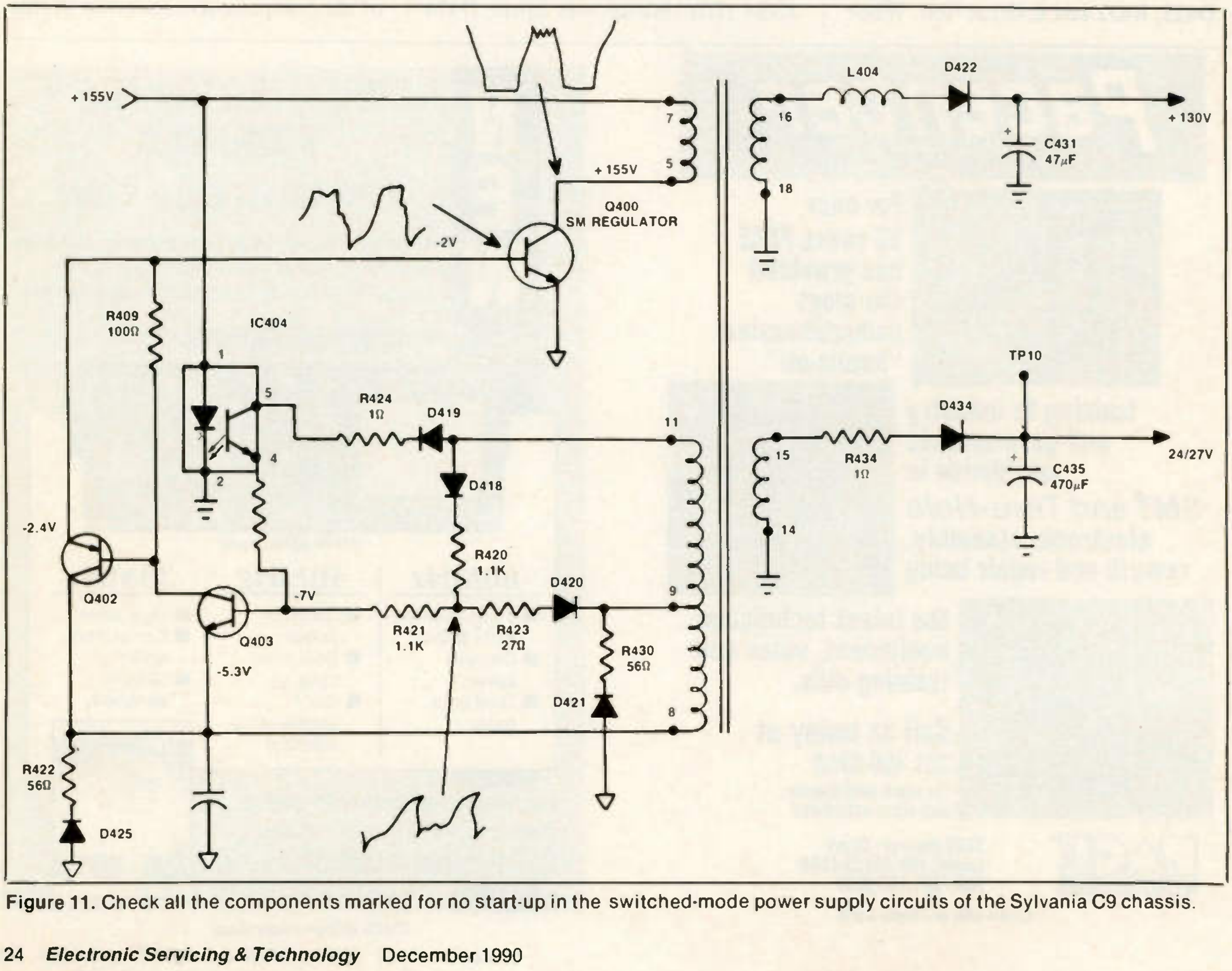


Figure 11. Check all the components marked for no start-up in the switched-mode power supply circuits of the Sylvania C9 chassis.

ES&T Profax
Manufacturers' schematics

December 1990

Profax Number

RCA
CTC 91 Color TV..3071

CHASSIS SCHEMATIC—DEFLECTION CIRCUIT

Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

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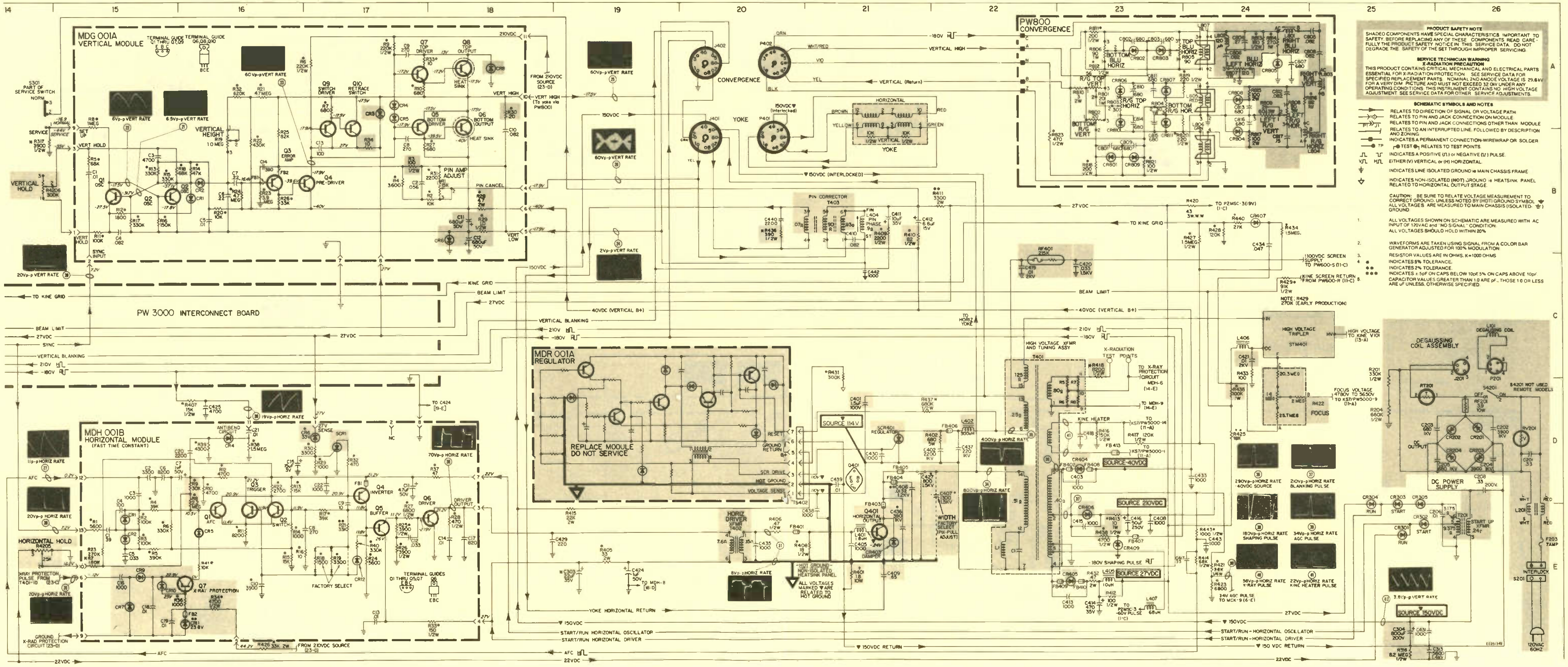
All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.



PRODUCT SAFETY NOTE
SHADED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY. BEFORE REPLACING ANY OF THESE COMPONENTS READ CAREFULLY THE PRODUCT SAFETY NOTICE IN THIS SERVICE DATA. DO NOT DEGRADE THE SAFETY OF THE SET THROUGH IMPROPER SERVICING.

SERVICE TECHNICIAN WARNING
X-RADIATION PRECAUTION
THIS PRODUCT CONTAINS CRITICAL MECHANICAL AND ELECTRICAL PARTS ESSENTIAL FOR X-RADIATION PROTECTION. SEE SERVICE DATA FOR SPECIFIED REPLACEMENT PARTS. NOMINAL 2ND ANODE VOLTAGE IS 29.6kV FOR A VERY DIM PICTURE AND MUST NOT EXCEED 32.0kV UNDER ANY OPERATING CONDITIONS. THIS INSTRUMENT CONTAINS NO HIGH VOLTAGE ADJUSTMENT. SEE SERVICE DATA FOR OTHER SERVICE ADJUSTMENTS.

SCHEMATIC SYMBOLS AND NOTES

RELATES TO DIRECTION OF SIGNAL OR VOLTAGE PATH
RELATES TO PIN AND JACK CONNECTION ON MODULE
RELATES TO PIN AND JACK CONNECTIONS OTHER THAN MODULE
RELATES TO AN INTERRUPTED LINE, FOLLOWED BY DESCRIPTION AND ZONING
INDICATES A PERMANENT CONNECTION-WIREWRAP OR SOLDER
TP TEST RELATES TO TEST POINTS.
INDICATES A POSITIVE (⎍) or NEGATIVE (⊔) PULSE.
EITHER (V) VERTICAL or (H) HORIZONTAL.
INDICATES LINE ISOLATED GROUND ie MAIN CHASSIS FRAME
INDICATES NON-ISOLATED (HOT) GROUND ie HEATSINK PANEL RELATED TO HORIZONTAL OUTPUT STAGE.

CAUTION: BE SURE TO RELATE VOLTAGE MEASUREMENT TO CORRECT GROUND. UNLESS NOTED BY (HOT) GROUND SYMBOL ALL VOLTAGES ARE MEASURED TO MAIN CHASSIS (ISOLATED) GROUND

1. ALL VOLTAGES SHOWN ON SCHEMATIC ARE MEASURED WITH AC INPUT OF 120VAC and "NO SIGNAL" CONDITION. ALL VOLTAGES SHOULD HOLD WITHIN 20%

2. WAVEFORMS ARE TAKEN USING SIGNAL FROM A COLOR BAR GENERATOR ADJUSTED FOR 100% MODULATION

3. RESISTOR VALUES ARE IN OHMS. K=1000 OHMS

4. ● INDICATES 5% TOLERANCE.
●● INDICATES 2% TOLERANCE.
●●● INDICATES ± 5pF ON CAPS BELOW 10pF, 5% ON CAPS ABOVE 10pF.

5. CAPACITOR VALUES GREATER THAN 1.0 ARE pF, THOSE 1.0 OR LESS ARE uF UNLESS OTHERWISE SPECIFIED.

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SS&T Manufacturers' schematics PROFAX 3071

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Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

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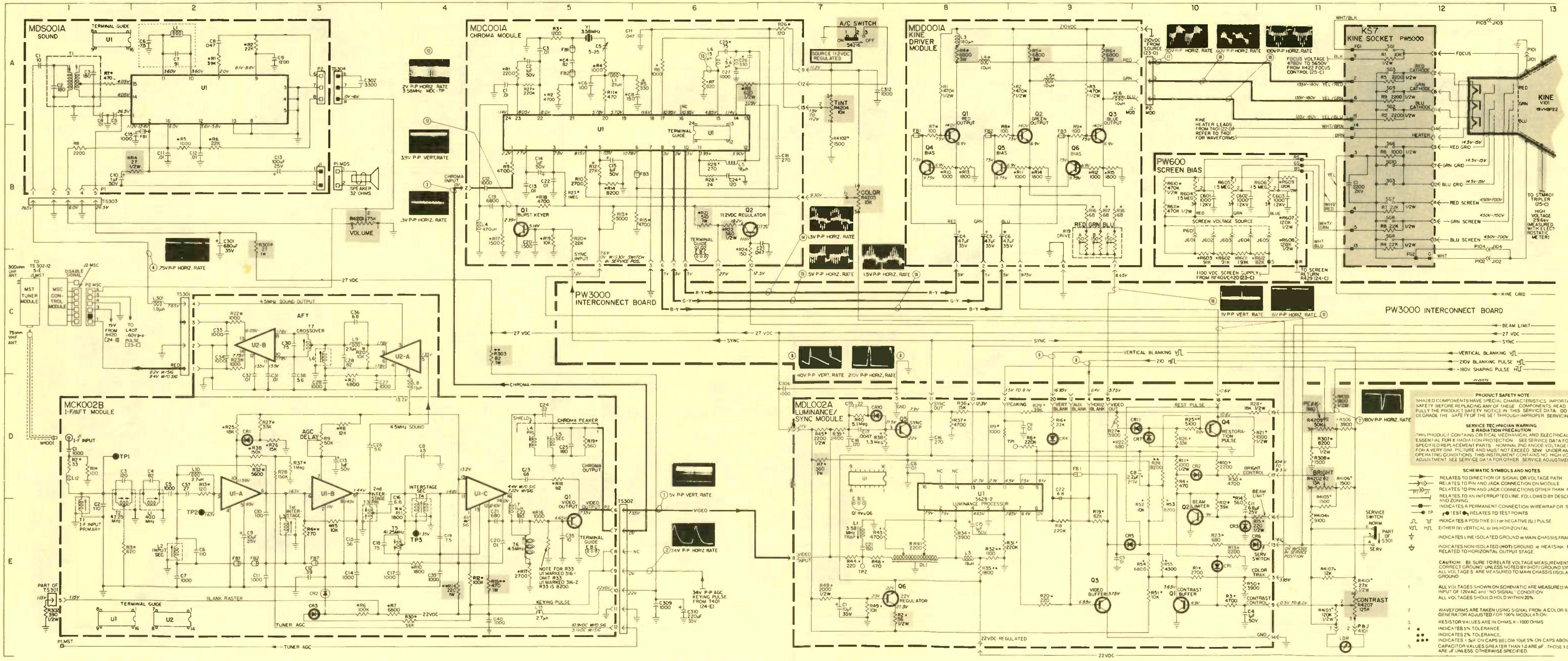

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FREQUENCY SYNTHESIS
TUNER CONTROL SCHEMATIC

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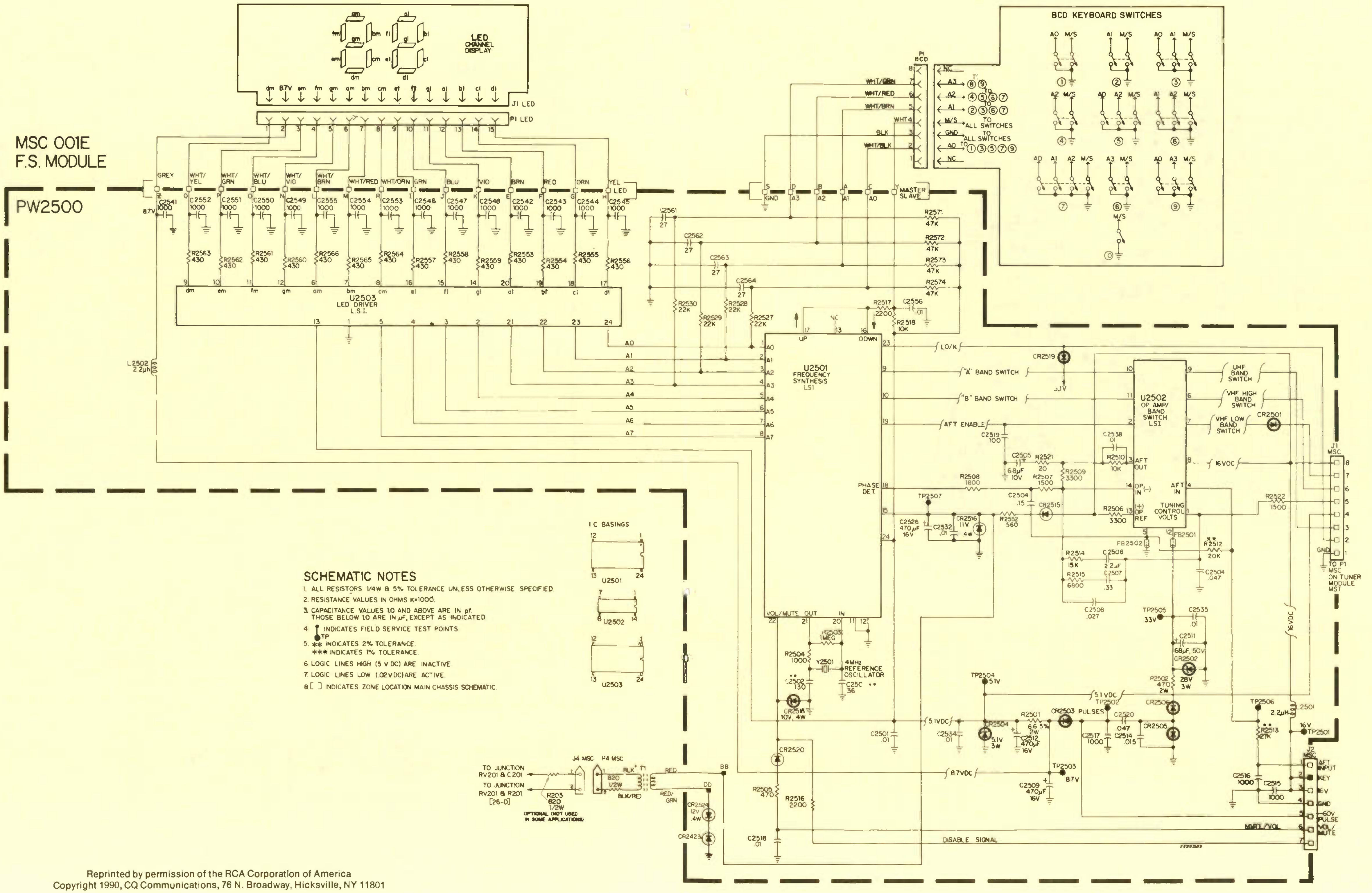

SCHEMATIC NOTES

1. ALL RESISTORS 1/4W & 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.
2. RESISTANCE VALUES IN OHMS K=1000.
3. CAPACITANCE VALUES 1.0 AND ABOVE ARE IN pf. THOSE BELOW 1.0 ARE IN µF, EXCEPT AS INDICATED
4. ● TP INDICATES FIELD SERVICE TEST POINTS
5. ** INDICATES 2% TOLERANCE.
   *** INDICATES 1% TOLERANCE.
6. LOGIC LINES HIGH (5 V DC) ARE INACTIVE.
7. LOGIC LINES LOW (.02VDC) ARE ACTIVE.
8. [ ] INDICATES ZONE LOCATION MAIN CHASSIS SCHEMATIC.

TUNER MODULE

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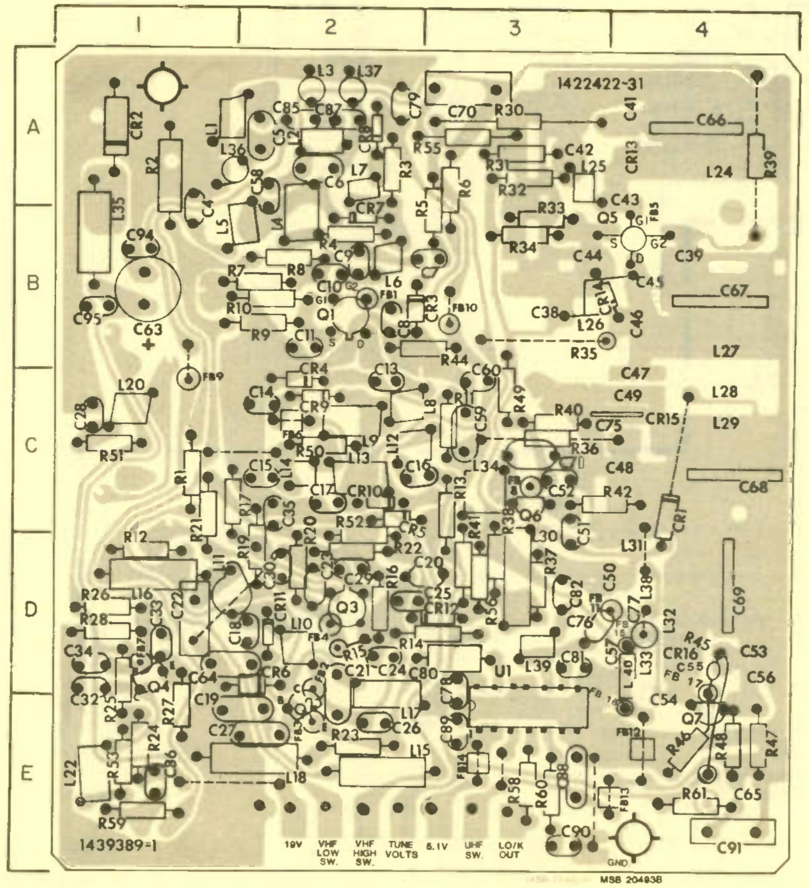

MST 009A—Component Location Guide

C2404	1B
C2405	2A
C2406	2A
C2407	3B
C2408	2B
C2409	2B
C2410	2B
C2411	2B
C2413	2C
C2414	2C
C2415	2C
C2416	2C
C2417	2C
C2418	2D
C2419	1E
C2420	3D
C2421	2D
C2422	1D
C2423	2D
C2424	2D
C2425	2D
C2426	2E
C2427	2E
C2428	1C
C2429	2D
C2430	2D
C2432	1D
C2433	1D
C2434	1D
C2435	2C
C2438	3B
C2439	4B
C2441	4A
C2442	3A
C2443	3A
C2444	3B
C2445	4B
C2446	4B
C2447	4B
C2448	4C
C2449	4C
C2450	3D
C2451	3C
C2452	3C
C2453	4D
C2454	4D
C2456	4D
C2457	4D
C2458	2A
C2459	3C
C2460	3C
C2463	1B
C2464	1D
C2465	4E
C2466	4A
C2467	4B
C2468	4C
C2469	4D
C2470	3A
C2471	3C
C2475	3C
C2476	3D
C2477	4D
C2478	3E
C2479	2A
C2480	3D
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C2482	3D
C2485	2A
C2486	1E
C2487	2A
C2488	3E
C2489	3E
C2490	3E
C2491	4E
C2494	1B
C2495	1B
CR2401	4C
CR2402	1A
CR2403	2B
CR2404	2C
CR2405	2C
CR2406	2D
CR2407	2B
CR2408	2A
CR2409	2C
CR2410	2C
CR2411	2D
CR2412	3D
CR2413	4A
CR2414	3B
CR2415	4C
CR2416	4D
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FB2402	2D
FB2403	2E
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FB2413	4E
FB2414	3E
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L2402	2A
L2403	2A
L2404	2B
L2405	1B
L2406	2B
L2407	2A
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L2409	2C
L2410	2D
L2411	1D
L2412	2C
L2413	2C
L2414	2C
L2415	2E
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L2417	2E
L2418	2E
L2420	1C
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L2424	4A
L2425	3A
L2426	3B
L2427	4B
L2428	4C
L2429	4C
L2430	3D
L2431	4D
L2432	4D
L2433	4D
L2434	3C
L2435	1B
L2436	1C
L2437	2A
L2438	4D
L2439	3D
Q2401	2B
Q2402	2E
Q2403	2D
Q2404	1D
Q2405	3B
Q2406	3C
Q2407	4E
R2401	1C
R2402	1A
R2403	2A
R2404	2B
R2405	3A
R2406	3A
R2407	2B
R2408	2B
R2409	2B
R2410	2B
R2411	3C
R2412	1D
R2413	3C
R2414	3D
R2415	2D
R2416	2D
R2417	1C
R2419	2D
R2420	2D
R2421	1C
R2422	2D
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R2425	1E
R2426	1D
R2427	1E
R2428	1D
R2430	3A
R2431	3A
R2432	3A
R2433	3B
R2434	3B
R2435	3B
R2436	3C
R2437	3D
R2438	3D
R2439	4A
R2440	3C
R2441	3D
R2442	3C
R2443	4D
R2444	3B
R2445	4D
R2446	4E
R2447	4E
R2448	4E
R2449	3C
R2450	2C
R2451	1C
R2452	2C
R2453	1E
R2455	3A
R2456	3D
R2458	3E
R2459	1E
R2460	3E
R2461	4E
U2401	3D

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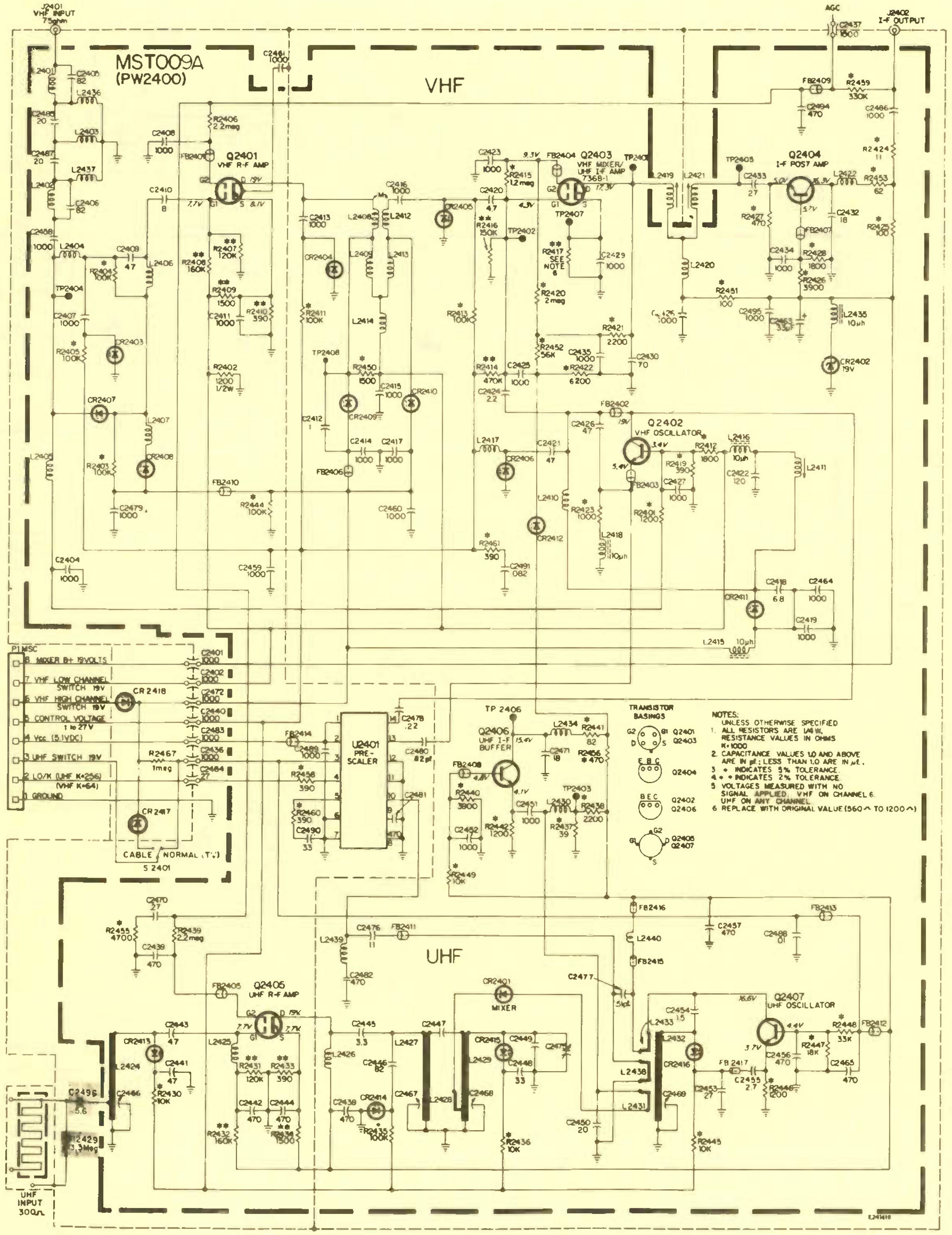
STAR or SHADING (*)
See PRODUCT SAFETY NOTICE
on page 2 of this Service Data.



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Test equipment update

By the ES&T staff

As consumer electronics products become more varied and far more sophisticated, the test equipment used by a typical servicing technician becomes, in turn, more varied and sophisticated.

The bare bones arsenal of the servicing technician used to require little more than a VOM and a moderate-bandwidth oscilloscope. Nowadays a servicing technician who tries to get by with no more than that complement of test equipment is kidding himself. He'll be able to do some of the simpler procedures, but any difficult problem will require considerably more test equipment.

These days, a very basic set of test equipment includes the following:

- DMM
- 60MHz to 100MHz oscilloscope
- Isolation transformer
- DC power supply
- AC leakage tester
- Variable transformer

But don't forget, any time you'll be working on any of today's sophisticated consumer electronics products, you'll be handling microcircuits that are susceptible to electrostatic discharge damage, so it's imperative that you use products that will prevent that kind of damage:

- Antistatic mat
- Grounding wrist strap
- Non-static producing spray chemicals

Will you be doing VCR servicing? If so, you'll have to add these to your store of test equipment:

- Test tapes
- Light box
- Eccentricity gauge
- Back-tension meter
- Torque gauge

If you plan to work on personal computers, there are a few pieces of test equipment, and software, that you'll want to have on hand:

- Diagnostic software discs
- Head cleaning discs

Nowadays there are even more electronics products that come under the consumer area: fax machines, personal copiers, telephone answering machines and other home office products. A growing number of servicing organizations who have serviced the traditional home entertainment electronics products are now providing service for many of these products. These products may require that the service center acquire yet more sophisticated test equipment.

Local area networks

Once computers began being used in almost every facet of business, it began to make sense to connect them together in a kind of network so that all of the computers in an office or office complex could be tied together in order to share the data in the database. Even some consumer electronics service centers now have such a network. Any service center that has a number of computers located throughout the facility for use in tracking products has a network. Such a network is called a local area network (LAN). Such a network may consist of all the same kind of computer, or they could all be very different.

As anyone who has ever installed or serviced computers knows, it takes a new kind of thinking to service them. A problem may be caused by the hardware, or it could be caused by the software, or possibly some kind of combination of both. This kind of compounding of the problem of installation pales into insignificance when the problem is in a LAN. If there's a problem in installation, or later on during operation, where does the fault lie? Is it in one of the computers, or somewhere in the network wiring? Is it hardware or software? You get the idea.

The following article on LAN testing describes the test equipment needed to service LANs, and talks about some of the pitfalls and solutions of servicing LANs.

Test equipment for LAN troubleshooting

By Dave Lentsch

A local area network (LAN) is a truly wonderful and useful thing unless you're responsible for installing it or fixing it when it goes down. The ability to build a network from otherwise incompatible microcomputers and peripherals has transformed PCs into powerful workstations for large-scale corporate systems.

Types of LAN wiring

At the level of wiring, or the physical network layer, variations in LANs include:

- Wiring type
- Topology

Wiring type: The two major wiring types are twisted pair and coaxial. Twisted pair is telephone wire. It is relatively easy to splice and is terminated with modular connectors.

The two most common cable sizes are referred to as small and large Ethernet-type. Coax cables are relatively difficult to splice, and special T-connectors, or taps, are used at junctions. Cables are terminated with BNC twist-lock connectors.

Some networks can also utilize fiberoptic connections. Fiber is more difficult than either of the wire types to splice and requires special taps and connectors. Most LANs today use fiberoptic cable for long runs, such as between buildings on a campus or to reduce crowding in cable ducts. Electro-optic converters are used to interface the fiber with conventional wiring for connection to offices.

Topology: The topology of a LAN refers to its wiring pattern. The three most common types are star, bus, and ring (Figure A). Twisted-pair networks are often laid out in star topology. In star networks, there usually is a centrally located wiring closet that houses data concentrators and switching equipment.

In contrast to star networks, coax LANs typically have bus or ring topologies. There's usually a a single cable, the network backbone, that runs down hallways or through common walls. Offices are connected to the backbone through taps. In these topologies, there isn't any need to trace lines from a wiring closet to individual offices, and there are no concentrators. You simply connect the backbone to a network transceiver. However, the characteristic impedance, length, DC resistance, and noise must be verified, just as in twisted pair configurations.

Lentsch is Marketing Manager of Test and Measurement Instrumentation for Beckman Industrial Corporation.

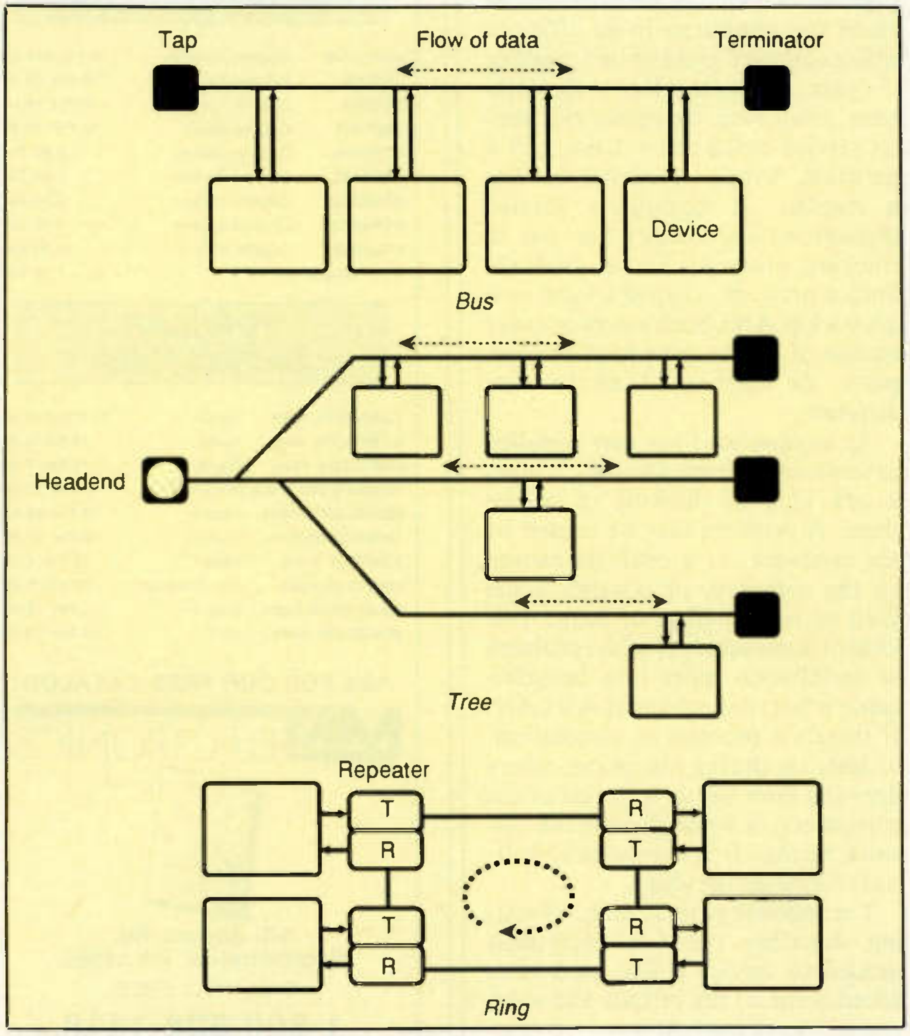


Figure A. Diagrams. Star, bus, and ring LAN topologies.

Diagnosing LAN problems

When a problem occurs in a LAN and the network wiring is the suspect, the quality of the wiring and its connections have to be verified. The test equipment needed for LAN testing includes an ohmmeter or DMM, a noise meter and a time delay reflectometer (TDR). One of the things you have to look for is noise. Perhaps some of the LAN wiring was located near a source of electrical noise that wasn't generating noise when the system was first installed and checked out. Or possibly, some source of noise has been installed since the LAN was installed.

You also want to discover if any high-resistance points, such as bad splices or connectors have developed. So, using the noise meter and the TDR, each line must be inspected for noise and signal attenuation. The noise meter gives clues to problems and their location, such as induction from lighting or power circuits, as well as motor hum or switching spikes from air conditioning units, copiers, or elevators. The TDR can also indicate opens and shorts.

Automated test procedures

Testing procedures, whether during installation or fault diagnosis can be streamlined with an automatic LAN test instrument. One such unit is the TMT-1 Transmission Medium Tester. It can be used to trace cables and for quality assurance. The tester can also be used to troubleshoot existing wiring, even to detect wiretaps.

Test functions

In its AutoTest mode, the tester can step through a predefined sequence of five tests that provide a thorough checkout of the network physical layer, for each line or cable. Once the cable type is selected (coax or twisted pair), a sequence of tests is performed at the touch of a button. In AutoTest, preset high/low limits are checked for all tests, providing a quick Go or No-Go determination for each line or cable. Presets can be changed either temporarily or permanently.

Individual tests can be performed in the diagnostic mode. That is, the tester performs any test in any sequence, as selected by the operator. The purpose of performing tests selectively is to concentrate troubleshooting or certification tasks on a particular problem that has been identified in the AutoTest sequence.

Other modes are available for altering and resetting test limits and calibration of the tester. The operator in the field normally would not be concerned with these modes.

These test functions are available

Line mapping verifies the pin-to-pin wiring connections of a twisted-pair connection. Using the supplied accessory terminators, the test also reports the office number of each line. This test is skipped for coax networks.

DC resistance detects shorts and opens. A shorting terminator must have been installed on the line. The loop resistance of the shorted cable is measured to 0.1Ω. In AutoTest mode, default high limits are applied to test for open circuit or poor connections. The default high limit for coax is 10Ω and the limit for twisted pair is 16.8Ω. Users may also select their own test limits. The DC Ohms test can be used for office identification, where terminator resistances of 200 to 444Ω are used to verify LAN routing. Higher resistances can also be used to flag office terminations in coax networks.

Noise testing helps trace sources of noise by location, frequency, and level. A matching terminator must be installed on the line. In diagnostic mode, by toggling the COUNT or AVERage switch, you can select either measurement of noise impulses greater than a preset threshold (count per 100 seconds) or time-averaged noise amplitude (RMS) for any of three bandwidths. (The frequency of any noise is a strong clue to its source). AutoTest looks only at noise impulse. The default threshold is 70mV and the high limit count is 2 impulses. To suit the requirements of the installation's LAN type and environment, users may select their own test limits.

Impedance testing is done with a shorting terminator. The test measures characteristic impedance of coax or twisted pair lines, over the range 45-175Ω and also automatically matches line impedance at the source. The impedance—as well as the distance to the terminator—are

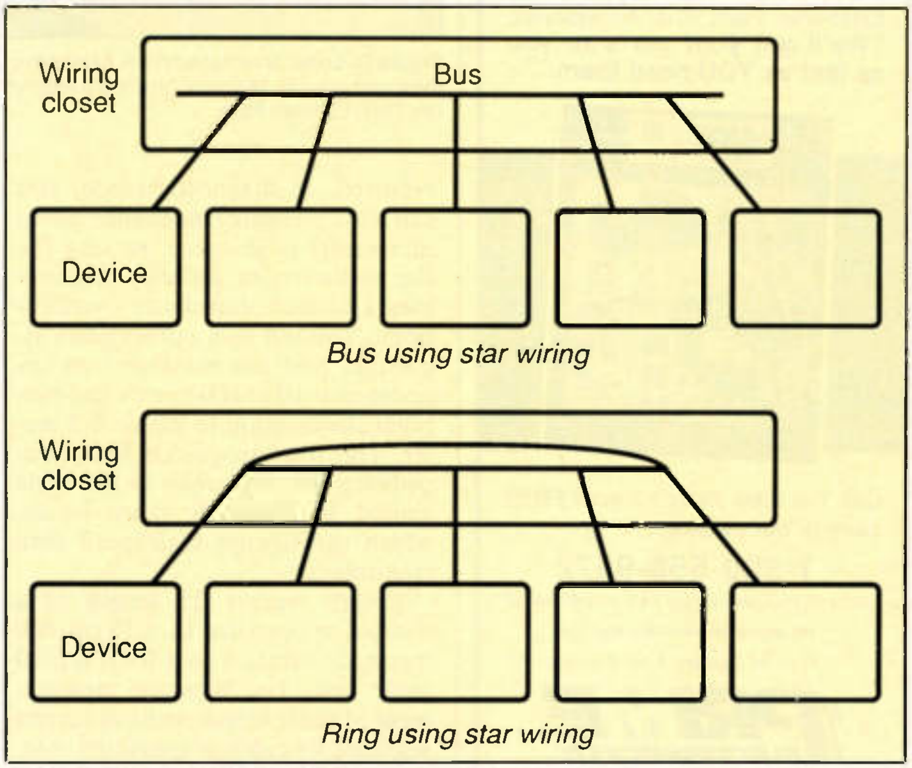


Figure B. Bus and ring topologies using star wiring.

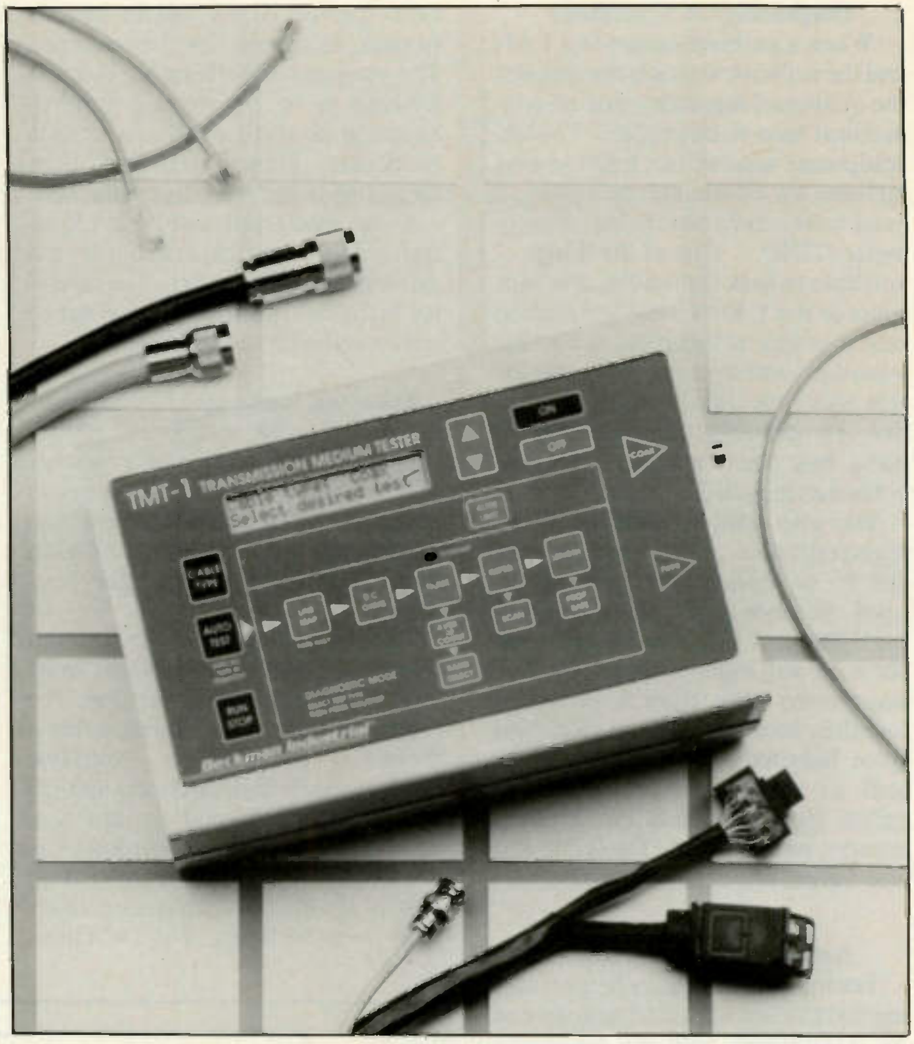


Figure C. Local area networks (LANs) offer unique troubleshooting problems because of their complexity. Manufacturers are responding with specialized test equipment, such as the TMT-1 shown here.

reported. In diagnostic mode, you can also measure impedance along increments of distance, or scan the line to determine distance measurements to each impedance overlimit point. This test uses a proprietary algorithm that can measure true impedance at 10 or 600 meters and pinpoint the location to within 0.3 meter. This test can quickly locate impedance discontinuities in the cable caused by kinks or sharp bends, which can disrupt high-speed data transmission.

Length reports the length of a shorted or open line to ±30 cm/600 meter, or within 1 foot for a typical cable run. The accurate measurement of cable length requires correct selection of cable propagation rate, or signal speed relative to the speed of light (C). Factory preset values are 0.77C for coax and 0.65C for twisted pair. In diagnostic mode, each of these preset values may be altered if a more accurate value for propagation rate is known for the specific cable type being used. Or, you can attach a cable of known length and the tester will calculate the exact propagation rate for that cable type.

In AutoTest mode, an important use of the LENGTH test is to assure that the overall length of the LAN does not exceed specifications for optimum signal strength. If the total cable run exceeds specified length, the signal will be attenuated unacceptably and usually a repeater must be installed. The AutoTest mode uses high limits of 185 meters for coax networks, 70 meters for twisted pair.

Test your electronics knowledge

By Sam Wilson

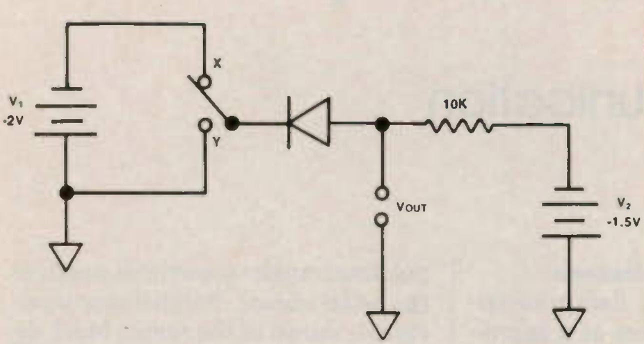


Figure A.

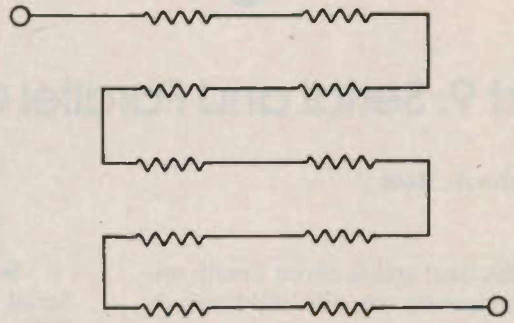


Figure C.

ALL RESISTORS ARE 0.62Ω +,- 10%

1. Which of the following is correct regarding VMOS power transistors?

A. They are a special form of JFET.

B. They are a special form of depletion MOSFET.

C. They are a special form of enhancement MOSFET.

D. They are a special form of bipolar junction transistor.

2. The dc input resistance of a VMOS transistor is

A. high

B. low

3. Which class of operation is used for bipolar transistors in push-pull circuits? Class_____________.

4. In all semiconductor symbols, the arrow points

A. in the direction of conventional current (assuming current could flow).

B. toward an N-type material.

C. Both choices are correct.

D. Neither choice is correct.

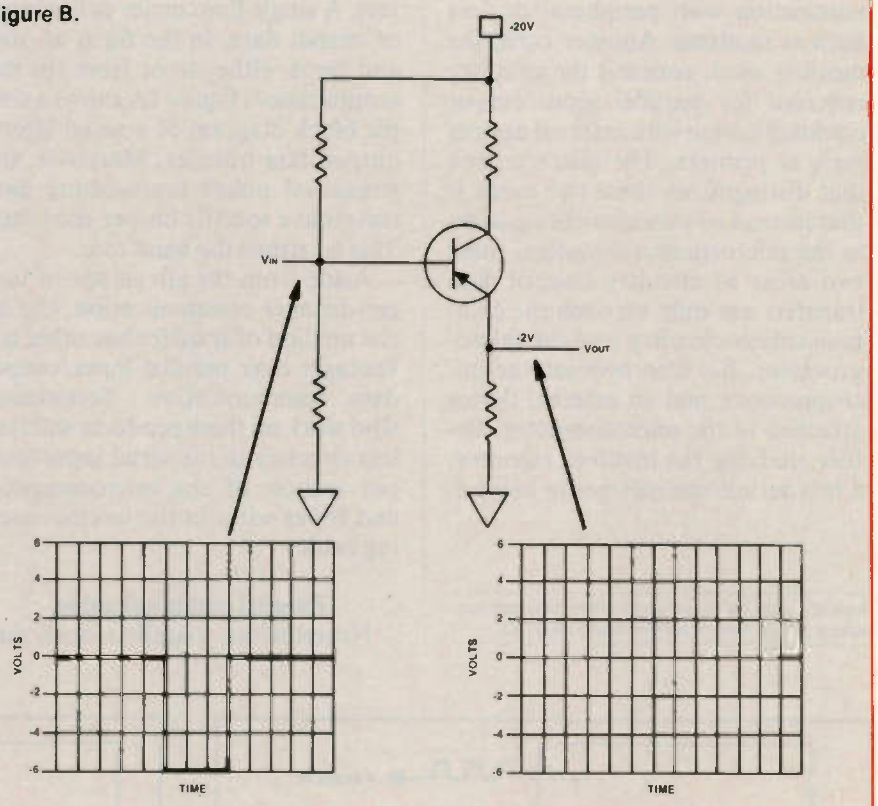
5. Assume the diode in Figure A has zero forward resistance and infinite reverse resistance. Write the values of Vout for the switch positions.

Vout for position x __________V.

Vout for position y __________V.

6. In the circuit of Figure B, draw the output waveform that the negative input pulse will produce.

Figure B.



7. A certain R-C filter is made with one resistor and one capacitor. It is called a single pole filter. Another name that is often used for this type of filter is ___________.

8. Dividing a change in voltage (V) by a corresponding change in current (I) gives ____________.

9. Is the following statement correct? "All thermistors have a negative temperature coefficient." (A similar device with a positive temperature coefficient is called a bead ledge.)

A. Correct

B. Not Correct

10. The 10 resistors in Figure C have a +, − 10% tolerance. All resistances are at the top of (+10% of their rating. So if each resistor is 0.62K, the total resistance is 6.2K + (100% of 6.2) or 12.4K. Is that right?

A. Yes

B. No

(Answers on page 52)

Wilson is the electronics theory consultant for ES&T

Servicing Zenith microcomputers

Part 9: Serial and Parallel Communication

By John A. Ross

In this final article about Zenith microcomputers we will backtrack to two cards reviewed in previous articles. One card, the floppy disk controller card, contains the circuitry needed for serial input/output communication with peripheral devices such as modems. Another card, the memory card, contains the circuitry required for parallel input/output communication with external devices such as printers. The characteristic that distinguishes these two cards is that instead of communicating within the microcomputer system, these two areas of circuitry control data transfers not only between the communication circuitry and the microprocessor, but also between the microprocessor and an external device attached to the microcomputer. Before studying the involved circuitry, a few definitions may prove helpful.

Serial communications

Serial input/output data transfer fulfills the requirements of a microcomputer system needing to communicate with an external device located within a few feet or several hundred feet. A single line carries either input or output data, in the form of ones and zeros, either to or from the microprocessor. Figure 1A shows a simple block diagram of a serial input/output data transfer. Moreover, the stream of pulses representing data travels at a specific bit-per-time rate. This is termed the baud rate.

Aside from the advantage of longer-distance communication, the serial method of transfer has other advantages over parallel input/output data communication. Technicians who work on these products will find less circuitry in the serial input/output section of the microcomputer and fewer wires in the interconnecting cable.

Parallel communication

Nevertheless, parallel input/output data transfer sometimes stands as the better choice. Parallel communication, shown in the simple block diagram of Figure 1B, allows the transfer of groups of data bits at the same time. A microprocessor reads a group of input or output lines simultaneously. This speeds the data transfer action. Additionally, the transfer of data bit groups becomes useful when a mechanical device requires simultaneous individual bits for switching operations.

Looking at the back of the microcomputer, you'll see the standard male twenty-five pin parallel interface connector. Figure 2 shows the connector with signal designations for each pin. When you compare this connector to the serial connector, you'll notice that every pin of the parallel connector has a function which leads to a larger array of circuitry than that used in the serial data transfer process. Using parallel data transmission adds to the complexity of the microprocessor circuitry. Because of the transfer of data bit

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Ross is a technical writer and a microcomputer consultant for Ft. Hays State University, Hays KS.

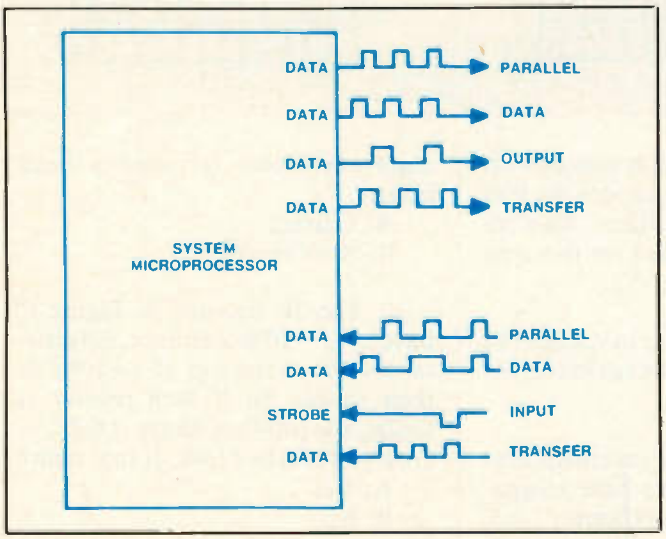


Figure 1A.

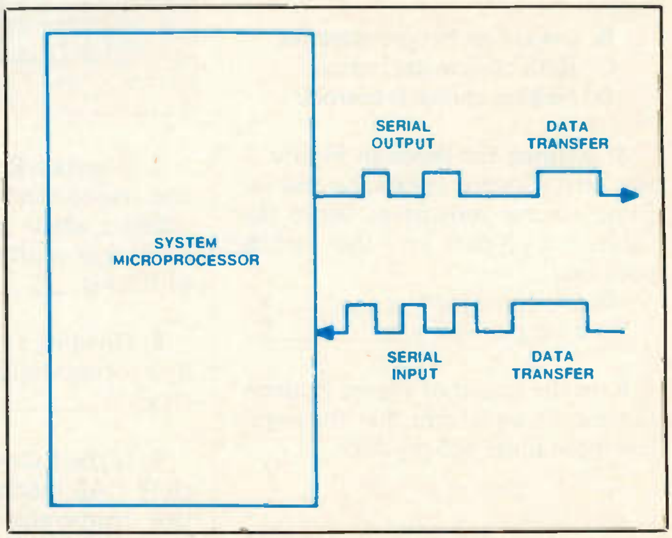


Figure 1B.

Figure 2.

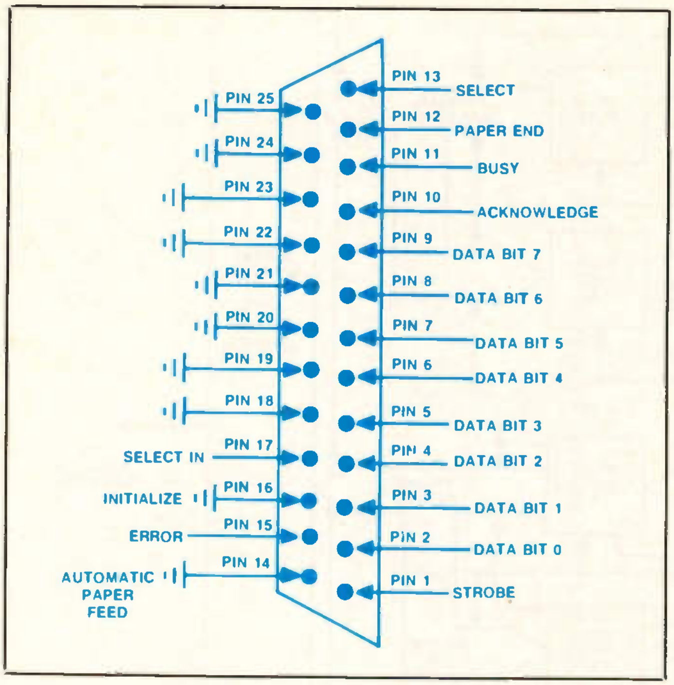
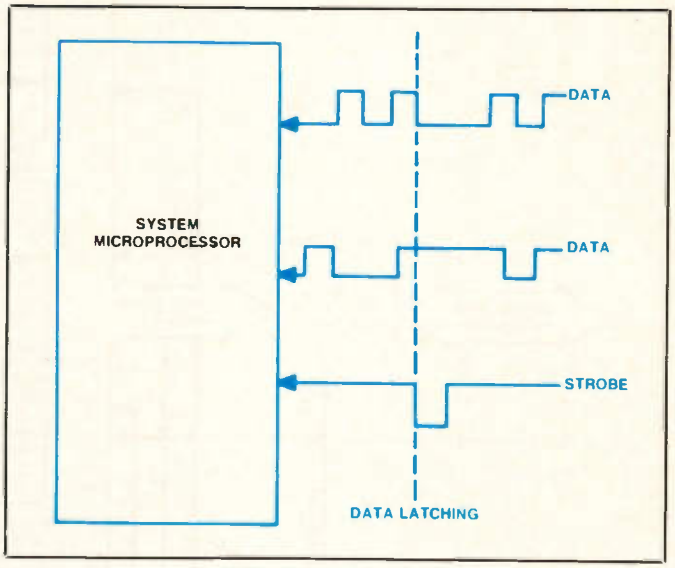


Figure 3.



groups, the system requires more bidirectional input/output lines than the processor can handle. Each bidirectional line uses additional gating circuitry to look like an input or an output line.

The signals used to communicate

Going back to Figure 2, several signals found at the parallel connector assist the microprocessor by indicating for the processor the state of the attached peripheral device. With the active low INIT signal at pin 16 the system initializes the peripheral device. As the microcomputer system communicates with a peripheral device such as a printer, the ACK signal, found at pin 10 of the connector, goes to a digital active low state to acknowledge that the device has received the data. Found at pin 11, the BUSY signal tells the system processor that the peripheral device has not finished processing a previous operation. Pin 15 of the connector carries the ERROR signal which indicates an error condition within the peripheral device. At pin 12, the PE or paper end signal tells the system that the printer has run out of paper. Pin 14 illustrates another paper signal, the AUTO FXDT or automatic feed signal, which requests a paper feed by the peripheral when at an active low. An active high SLCT or SELECT signal at pin 13 indicates the selection of the peripheral device by the processor. Another select signal, the SLCT IN signal at pin 17, shows that the peripheral device has selected the microcomputer system.

One signal exists as a data indicator for the system processor. Labeled as the STROBE signal at pin 1 of the connector, this signal tells the system processor that a group of valid data bits has appeared. This strobe signal distinguishes the valid data from the other logic signals found in the transmission. For the circuit registers, the strobe signal indicates when latching should begin. Figure 3 shows the relationship between the incoming group of data and the strobe signal.

In the Zenith 150-series design, the parallel port can reside on either the CPU/memory card which features a gate array, or on a separate memory card. On the CPU/memory card, the gate array supplies most of the functions needed for the parallel interface. For the purposes of this article, we will take a look at the interface used on the memory card. A 25-pin connector, an address decoder in the form of a programmable array logic integrated circuit, a tri-state buffer, three bus drivers and three data latches make up the parallel input/output circuitry. Figure 4 shows a block representation of the circuitry, while Figure 5 depicts the section of the memory card that supports the parallel input/output data transfer. Each memory card contains one parallel interface port. Configuration jumpers control the assignment of a printer to one of two input/output ports or disable a particular port interface.

Circuitry for three different port sections works together as the data transfer process begins. Port A acts as the parallel data read/write port while port C is the device command port. Drive status signal data from the attached peripheral device flows through port B to the parallel data bus. The bus drivers, U452, U462, and U472, read incoming data and provide some error detection. U459, essentially a tri-state buffer, acts as an input/output data traffic controller for data between the system input/output bus and the connected external device. A programmable array logic IC provides address decoding in the form of the digital low write port A, read port A, read port B, write port C and read port C signals. At the end of the individual read or write cycles, these signals go to an active high state. Again in each case, the address enable signal goes to a

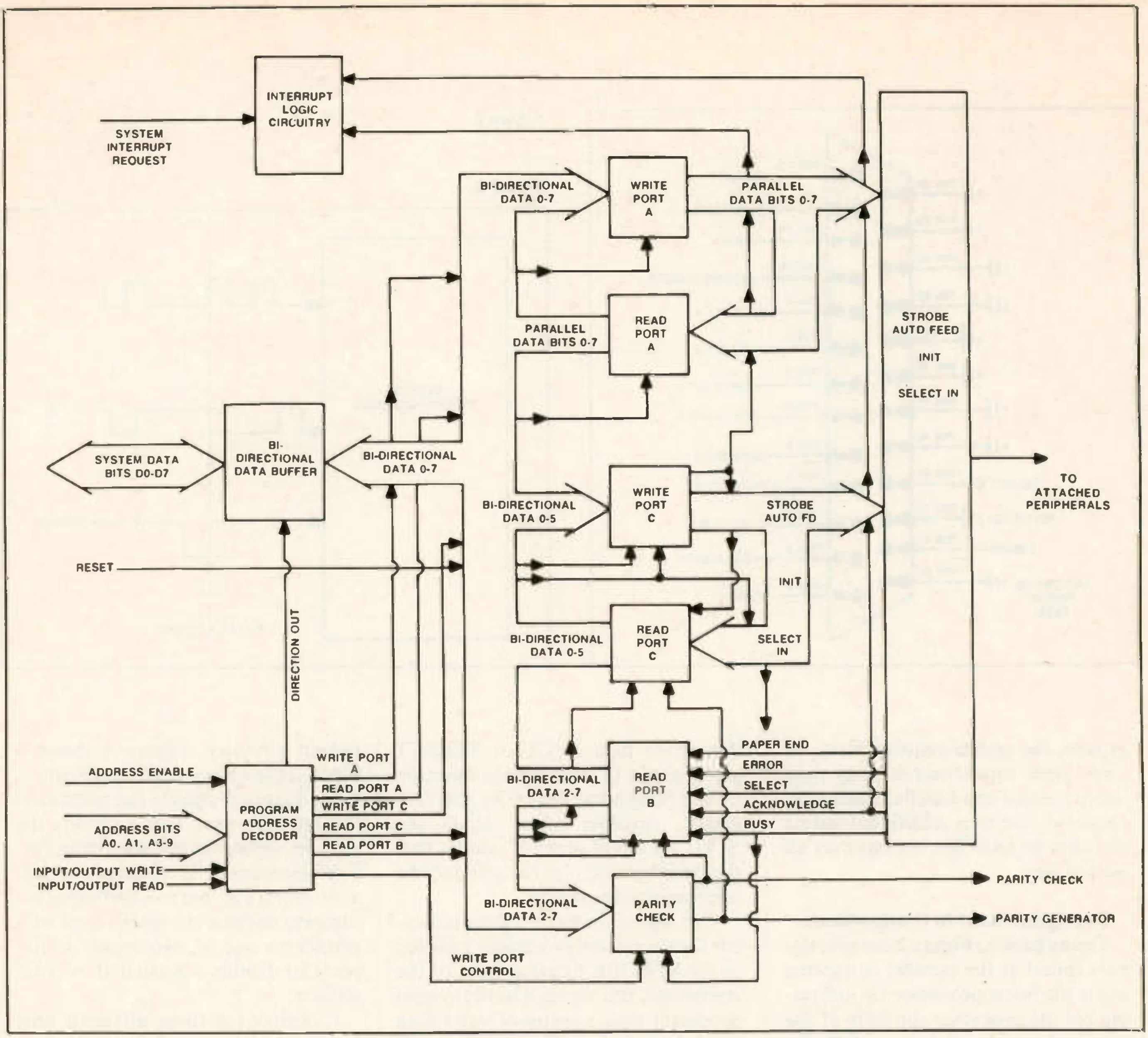


Figure 4.

digital low. Moreover, the input/output write and input/output read signals also go to a digital low state at the beginning of the read and write cycles. When detecting the carrier signal, the modem processor holds the CARRIER DETECT signal at a high state. This informs the microcomputer processor that the modem has connected with the phone line. Some modems rely on another signal, called the RING DETECT signal, to indicate both a phone connection and a ringing phone on the other end of the connection.

Serial communications protocol

Not surprisingly, considering the timing of the data stream, serial input/output communication requires a set protocol for data transmission. Instead of using clock pulse synchronization, most serial devices use an asynchronous interface which allows the computer and attached devices to process data whenever the data arrives. To differentiate the beginning of the data stream from the middle or end for the processors, the data package includes a start bit, data bits, parity bits and stop bits. Figure 6 illustrates the purpose of these bits in the data package. Here's an example of the protocols you'll encounter when working with serial data transmission: 2400 baud, seven bits, one stop bit, even parity. With this protocol, data transmits at a rate of 2400 bits per second and has an ASCII character length of seven bits. Adding one bit to the character length gives a parity bit that provides error checking like that found in memory circuitry. One stop bit signifies the end of the data character. Although the technician or user can change the protocol to allow for system requirements, the user must maintain consistency in the protocol settings between the attached devices in the serial transmission loop.

Moving to the actual circuitry in an early Zenith 150-series microcomputer, the floppy disk controller card contains the serial data input/output communication circuitry. Figure 7 shows the portion of the card that

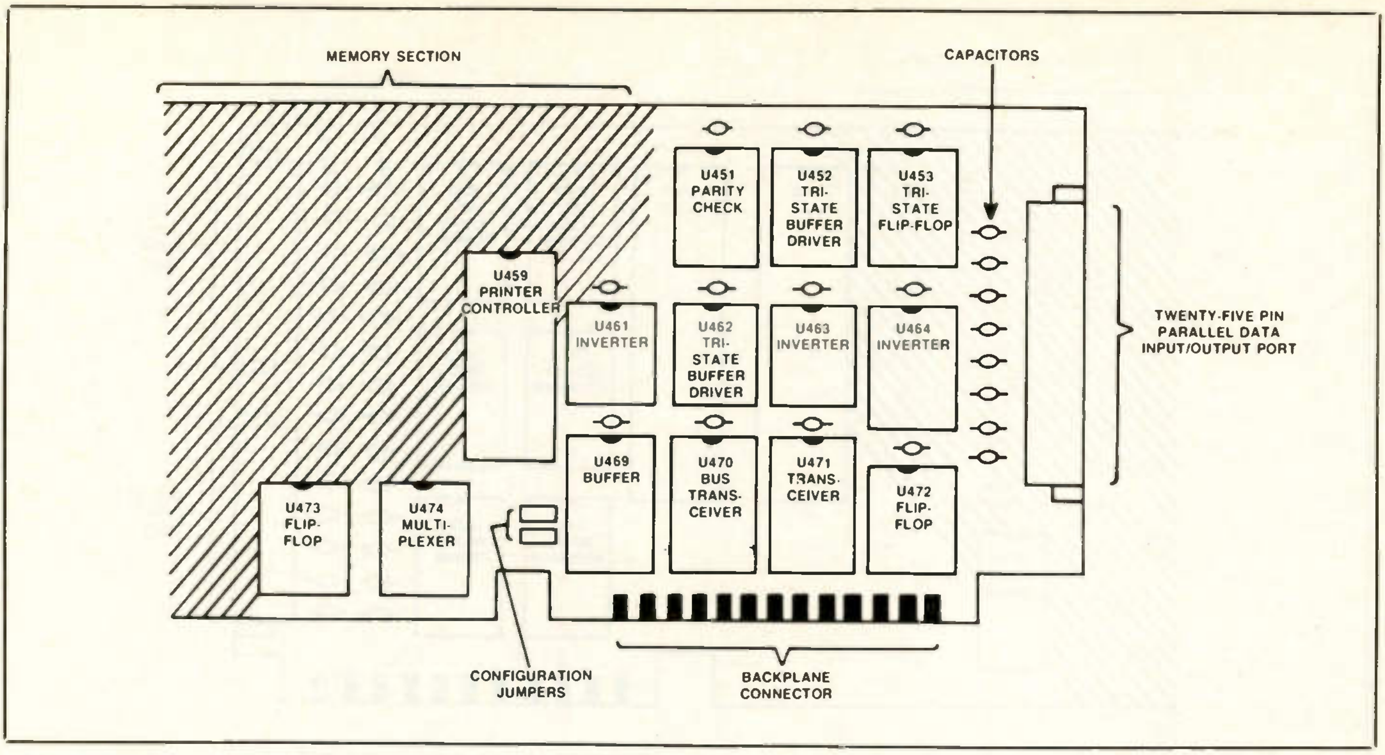


Figure 5.

contains the circuitry. Ten semiconductor devices control the circuit operation. U532, a logic array, decodes the card addressing when the address enable signal becomes active. Because the serial I/O signal features selectability between two ports on the card, two identical circuits reside on the card. U507, an asynchronous communication enable IC; U235, an RS-232 receiver; U523, an RS-232 driver; and U509, a buffer, connect with the 25-pin connector, P503, to control the COM1 port. U506, an asynchronous communication enable IC; U535, an RS-232 receiver; U536, an RS-232 driver; U508, a buffer; and the 25-pin connector, P504, work together to control the COM2 port. Selection of the two ports occurs through the generation of either the CSUA1 or CSUA2 addresses. Each of these respective addresses depends on whether address bit A8 has a low or high digital state. In the COM1 circuit, U509 and pin 1 of U522, the RS-232 receiver, interface the serial input to the input/output circuitry. In the COM2 circuitry, U535 and pin 4 of U522 accomplish the same task.

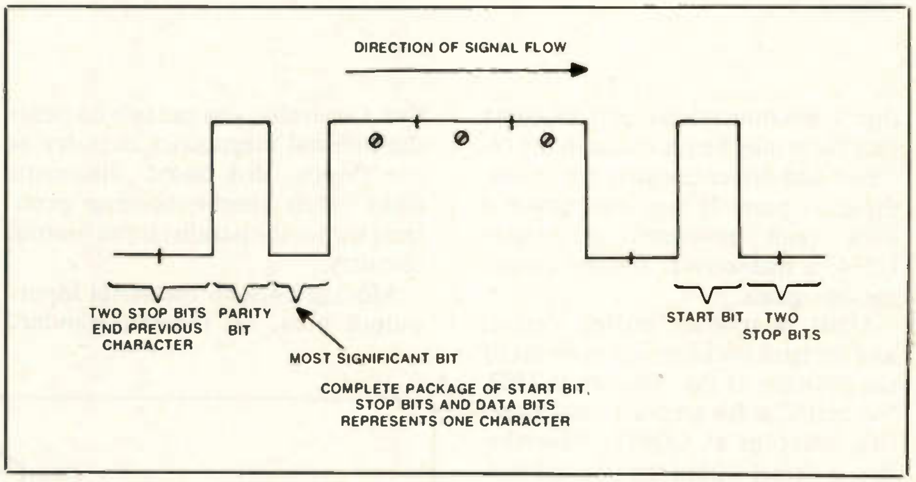


Figure 6.

Two signals from the microcomputer bus, the Input/Output Read, or IORD, and the Input/Output Write, or IOWR, signals set the receive or transmit functions for the transceiver circuitry. Another signal from the system bus, the RESET signal, clears the logic array and the circuit buffers. Two other signals from the logic array, the DIRCIO and GATE signal, control the direction of data flow through the transceiver, U534.

U520 gives the baud clock frequency base of 1.8432MHz. Any inconsistency in the baud rate may result from a defect within the integrated circuit. No frequency adjustments exist on the card. However, looking at each communications port, a defective U508 or U509 may also cause problems with the baud rates found at COM1 and COM2. A variance in the baud base frequency, caused by defects within U520, L599 or C574, may also cause either a no output, a data fault or a wrong baud rate condition on both communication channels to appear.

Troubleshooting the communications ports

Defects in other devices may cause similar problems. If you encounter either condition on both channels, check the input and output signals of the logic array, and make sure that supply voltages at the integrated circuits are within spec. No output at ei-

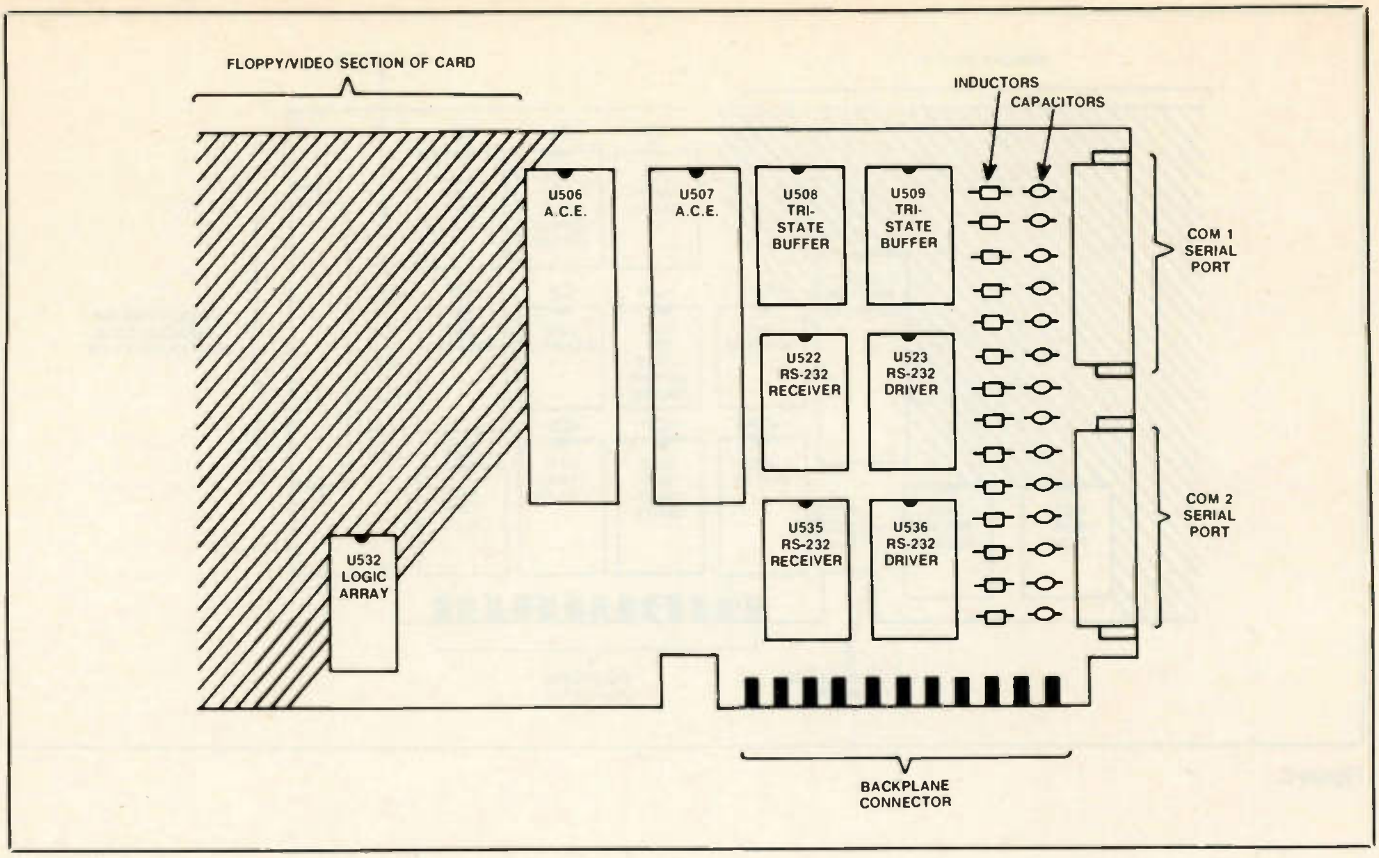


Figure 7.

ther communications port suggests that there may be problems in the receiver and driver circuitry for the individual port. If you experience a data fault problem, investigate U534, a transceiver, for the proper gating signals.

U508, a tri-state buffer, detects and initiates the interrupt cycle set by the position of the jumpers at J502. Normally, software will create an active interrupt at COM1. Nevertheless, a defect within the tri-state buffer may also trigger an interrupt at the same port. You will see an active interrupt at COM2 only when closing J502 with a jumper. Again, U508 may cause an interrupt error to appear. Configured as an L-C network, L599 and C574, along with other passive L-C filters, reduce radio-frequency emission levels at the card connectors.

Data latching for data ports A, B and C comes from U453, U463 and U473 respectively. Capacitors in each circuit act as noise suppressors. Both ports A and C provide convenient interfaces for performing error detection on the data sent to a printer. This error detection prevents false data from appearing on the data lines if an attached printer becomes defective. Generally, you can rely on either the internal diagnostics circuitry or on floppy disk-based diagnostic disks when troubleshooting problems within the parallel input/output circuitry.

Moving back to the serial input/output area, an industry-standard RS-232 connector, shown in Figure 8, defines the type of signal used and the signal transfer rate. This standard stems from the desire to provide flexibility in the design of microcomputers. Generally, all microcomputer equipment will feature the RS-232 connector for serial data transfer.

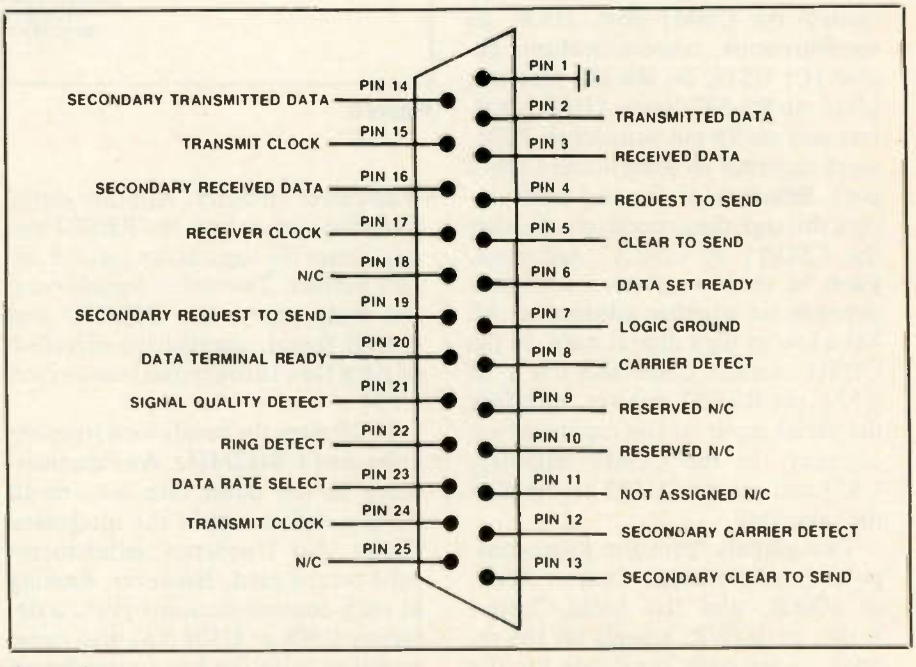


Figure 8.

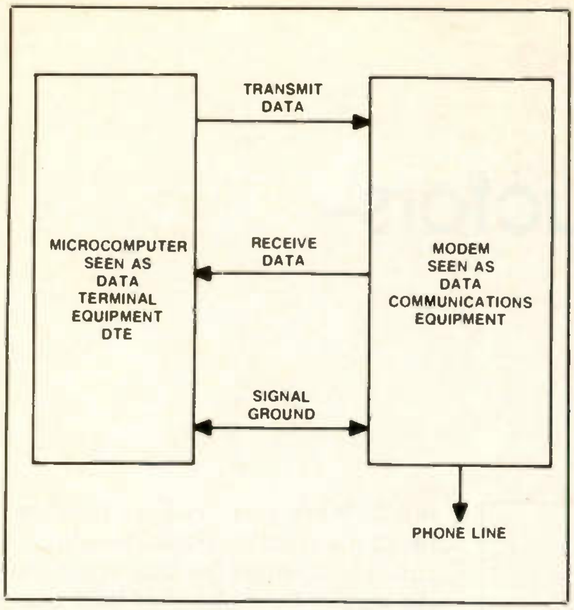


Figure 9A.

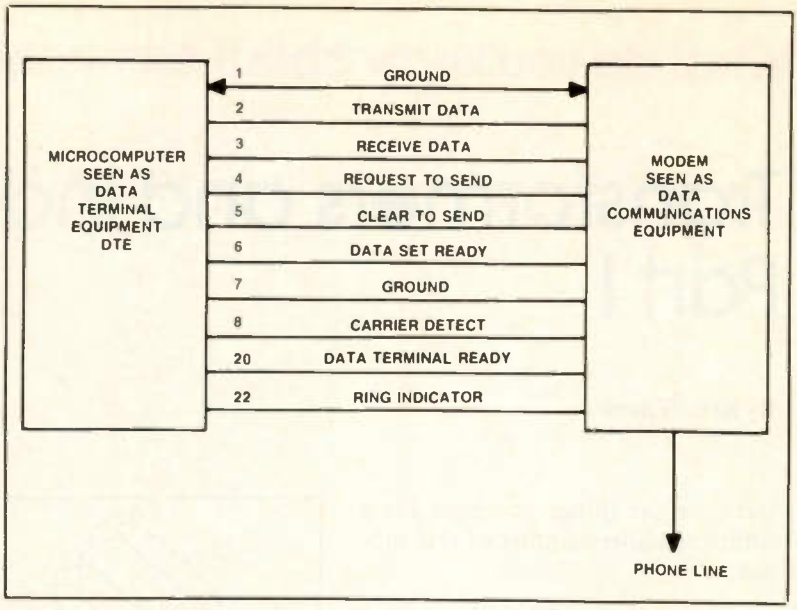


Figure 9B.

While the older Zenith 100-series microcomputers use 25-pin RS-232 connectors, labeled as DB-25 connectors, the newer models in the series use nine pin RS-232 connectors, called DB-9 connectors. Even though you may see as many as seven lines used in any given serial transmission system, the RS-232 system may operate with only three lines.

Those three lines carry the transmit data, receive data and ground signals between varying types of equipment. In any RS-232 system, one end of the link becomes designated as the DATA TERMINAL EQUIPMENT or DTE while the other end of the link stands as the DATA COMMUNICATIONS EQUIPMENT or DCE. As an example, a microcomputer system would show as the DCE while an attached modem or serial printer would show as the DTE. Figure 9A shows the relationship of the signals in a simple block diagram. Even though this simple diagram illustrates the serial data transfer process, Figure 9B shows the actual number of lines used in a real-life microcomputer/modem data transfer.

Before any transfer can take place between the microcomputer and the modem, several sequential changes must take place in the RS-232 signal levels. Those signals vary with the type of RS-232 "handshaking" operation used. Initially, in one type of operation, the DATA TERMINAL READY or DTR signal from the microcomputer will swing to an active high state which tells the modem, "I'm ready to send data." When the modem reaches the ready state, the processor inside the modem acknowledges the high DTR signal by causing the DATA SET READY signal to go to a digital high level. With both lines at the high or "true" state, the data transfer takes place.

In another type of RS-232 operation, the REQUEST TO SEND and CLEAR TO SEND signals serve as the "ready to send" and "ready to acknowledge" signals for the microcomputer and the modem. In another handshaking set, software controls the handshaking by sending control codes on the data lines. In the X-ON/X-OFF scheme, the microcomputer and the modem exchange the characters, DC1 and DC3. When these two special characters appear in the stream of data bits, the microcomputer or modem acknowledges the signal change.

Again looking at Figure 9B, several other lines come into play. As the modem links with the outside phone line, the modem processor should detect a carrier signal of an active phone line. As with other sections of the microcomputer, both the parallel and serial data transfer circuits rely on a specific MS-DOS configuration for the proper operation of the circuit. Some of these configuration commands vary with the version of the operating system used on the microcomputer. ■

What do you know about electronics?

Transformers and inductors–Part I

By Sam Wilson

Here are the things you need for a complete understanding of this subject:

- a review of some basic electric and electronic theory;
- a review of some basic physical laws and effects;
- a smattering of calculus that we will pick up (or review) as we go. I'm going to explain some of the calculus by using graphs;
- and, some time to understand this subject by reading it carefully.

Let's start with two very important physical laws and effects.

1. Faraday's Law: Any time there is relative motion between a conductor and a magnetic field there is always a voltage induced. It doesn't matter if the conductor is standing still and the magnetic field is moved through it. It doesn't matter if the magnetic field is standing still and the conductor is moved through it. It doesn't matter if they are both moving as long as there is motion between them. In other words, if you were standing on the conductor the magnetic field would appear to be moving through you.

The concept of induced voltage on the basis of changing flux is called the flux rule. It is also possible to induce a voltage without resorting to the relative motion of a conductor and flux. These exceptions to the flux rule are interesting, but, they are not related in any way to this discussion.

Later in this series I will discuss those exceptions so you will have a complete idea about induced voltage.

2. Lenz's Law: If a current flows as a result of the induced voltage, its magnetic field will always oppose the motion which produced that induced voltage.

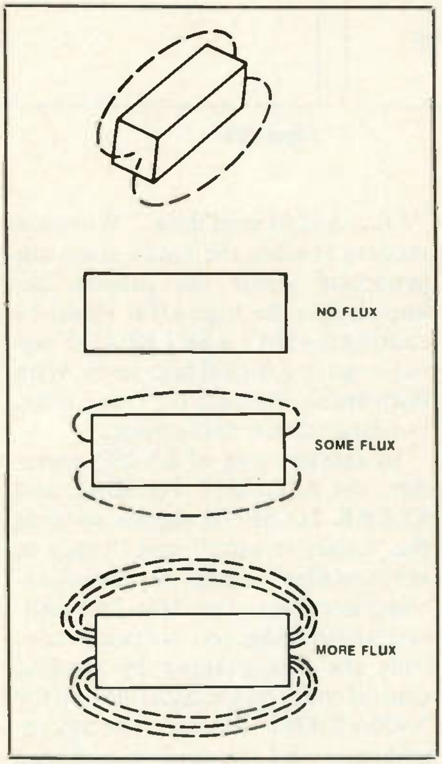


Figure 1.

A current that flows as a result of an induced voltage is called an induced current. With these basic ideas we can build an understanding of inductors and transformers.

Figure 1 shows that there is a magnetic field around a magnet. The magnetic field is represented by lines of flux. The number of magnetic flux lines depends upon the strength of the magnetism. Notice this important point: As the magnetism becomes stronger and stronger the number of flux lines increases, and, they move out from the magnetic material. You should remember that the illustration is a side view. As shown in the inset it can be a rectangular bar with the flux lines around it.

Suppose the rectangular bar has a coil of wire around it as shown in Figure 2. When the flux lines increase they cut across the turns of wire in the coil. The stronger the magnetic field the greater the number of lines that have cut through the conductors.

It is now time to add some more information about Faraday's Law. It isn't enough to say a voltage is induced. We need to know how much voltage and what does the amount of voltage depend upon?

The voltage depends directly upon the number of conductors (N) and the rate at which the flux is changing in the vicinity of the conductor. This is where the calculus comes in. In order to discuss things such as the rate of change in a way that allows us to do it economically and to put numbers to it requires that we use a branch of mathematics that can easily handle rates of change. That's what calculus, and more specifically, differential calculus, is all about.

The following physical example is intended to illustrate the principles involved. See Figure 3. Assume we have a device at the end of the bar as shown in Figure 3, that can measure the strength of the magnetic field. The magnetizing force is the current I. It produces a magnetic field in the magnetic material.

In the case that we're considering, the current I is changing. If you make a graph of the magnetizing force I and resulting strength of magnetic field $\emptyset$ you will get a curve like the one in Figure 3. If you change the magnetic material you will get a different curve.

Instead of using the magnetizing force for the horizontal axis on the graph, it will be assumed that the magnetizing force is increasing steadily with time (t). That means the current that produces the magnetizing force is also increasing steadily. At any instant of time 't' the corres-

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Wilson in the electronics theory consultant for **ES&T**

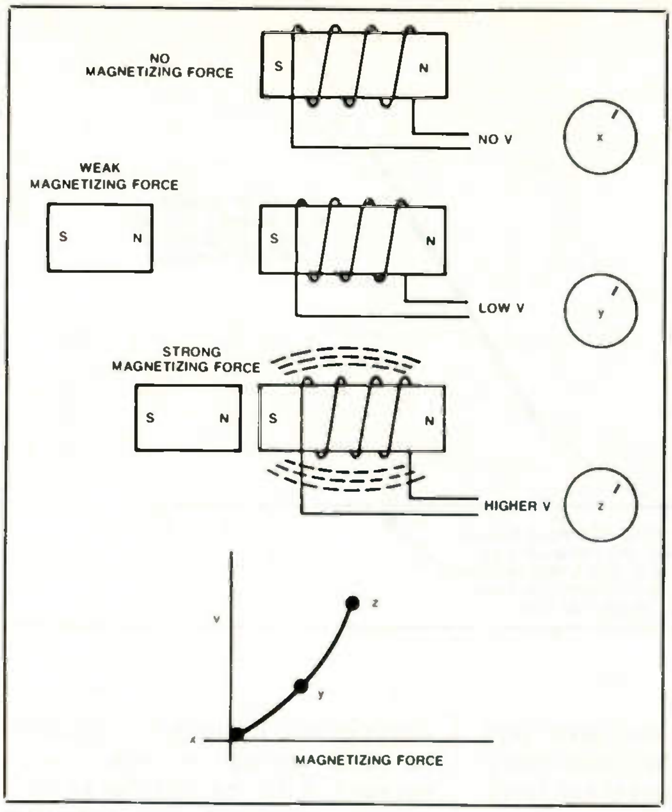


Figure 2.

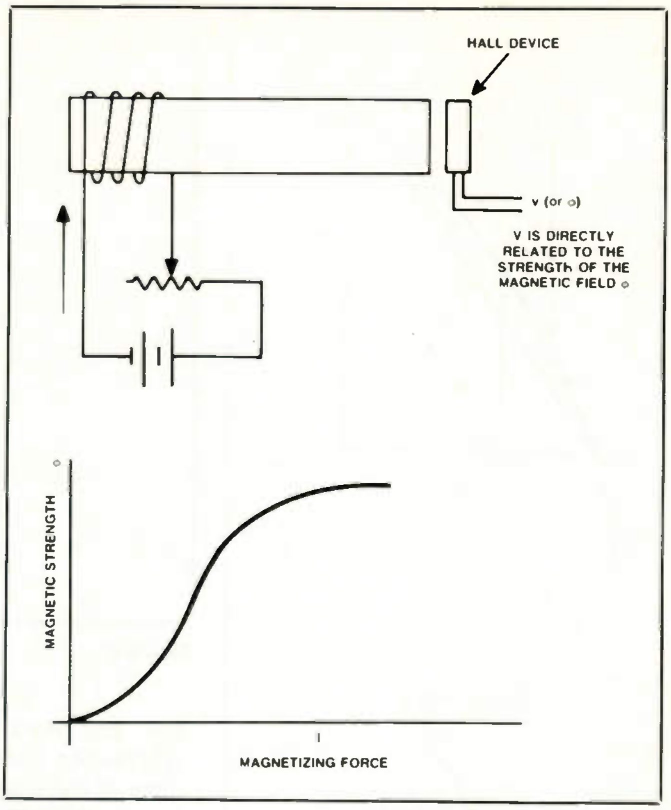


Figure 3.

ponding magnetic flux '∅' can be found in Figure 4.

The slope of the curve is defined as how fast you move up (or down) on a curve as you move from left to right. If you move from x to y on the curve, as shown in Figure 5, you will also move up from y to z.

Next, you make x and the corresponding value of y smaller. Call the new values x' and y'. A shown in Figure 5, the hypotenuse (line x'z') changes its angle.

Here is where you have to use your imagination. If you make x shorter and shorter the corresponding value of y will also get shorter and shorter. As x and y get shorter and shorter, the hypotenuse (line xz) will eventually be a tangent to the curve. This is shown in Figure 5. In other words, the rate at which y changes when x is changed can be represented by a tangent to the curve. The tangent to the curve is called the slope of the curve. The steeper the tangent line the greater the slope.

When Newton (and Leibnitz) first proposed this idea many of the well-known philosophers of that time called the idea ridiculous. They said "The lengths of x and y would have to be so short that they would be a single point on the line." That happens to be true! People who made fun of Newton and Leibnitz had space for rent in the attic.

Applying the concept of the slope

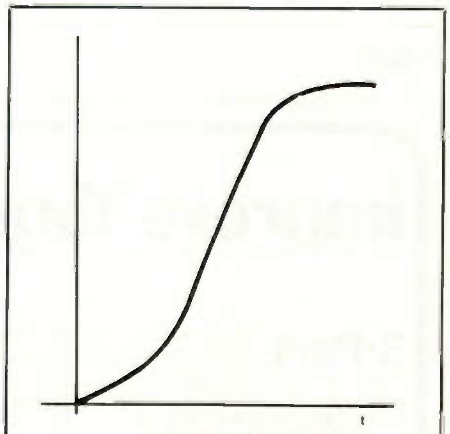
Now let's apply the idea of the slope to the curve of Figure 4. It is redrawn in Figure 6. The rate of change of flux ($^{d\varnothing}/_{dt}$) is another way of saying how fast the flux increases (or, decreases) with an increase (or, decrease) in magnetizing force. So, we call the horizontal line the rate of change of time (dt). The vertical line then becomes the rate of change of magnetic flux (d∅).

You just learned that you can determine the rate of change flux with respect to the rate of change of the magnetizing force by drawing a tangent to the curve at the point of interest. The steeper that tangent line the faster the flux is changing.

When you try to explain this in words it results in questions. So, I will now start to use symbols. This is the first equation that was discussed:

$$V = -N \times d\varnothing/dt.$$

The equation means that the induced voltage in the coil equals the number of turns of wire multiplied by the rate as which the flux lines are cutting through the turns.



THIS GRAPH ASSUMES THE MAGNETIZING FORCE INCREASES STEADILY AS TIME PASSES

Figure 4.

Refer again to Figure 3. The number of turns of wire is directly related to the inductance (L) of the coil. The rate of change of flux is related to the rate of change of current (I) in the coil. So, the equation can be written a different way:

$$V = -L\ [dI/dt]$$

Inventions

If you have ever tried to get financial backing for your invention you know the exact meaning of the word frustration. I've been through it a number of times and I can tell you it is the hardest part of inventing.

You have to admire Thomas Edi-

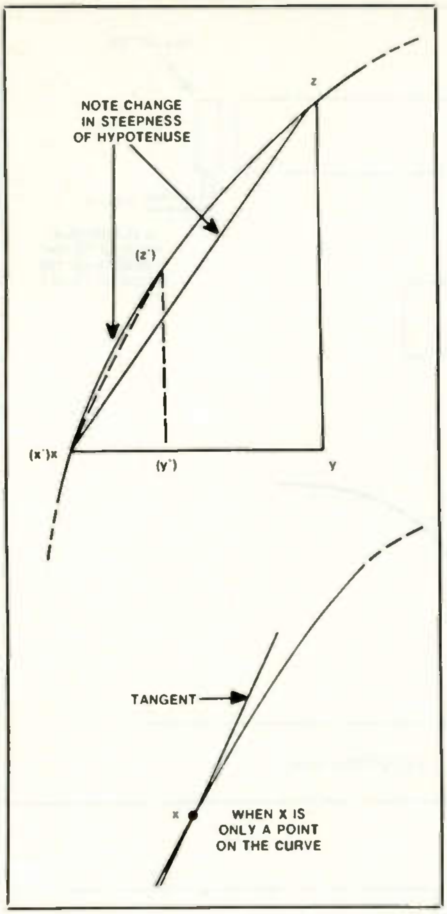


Figure 5.

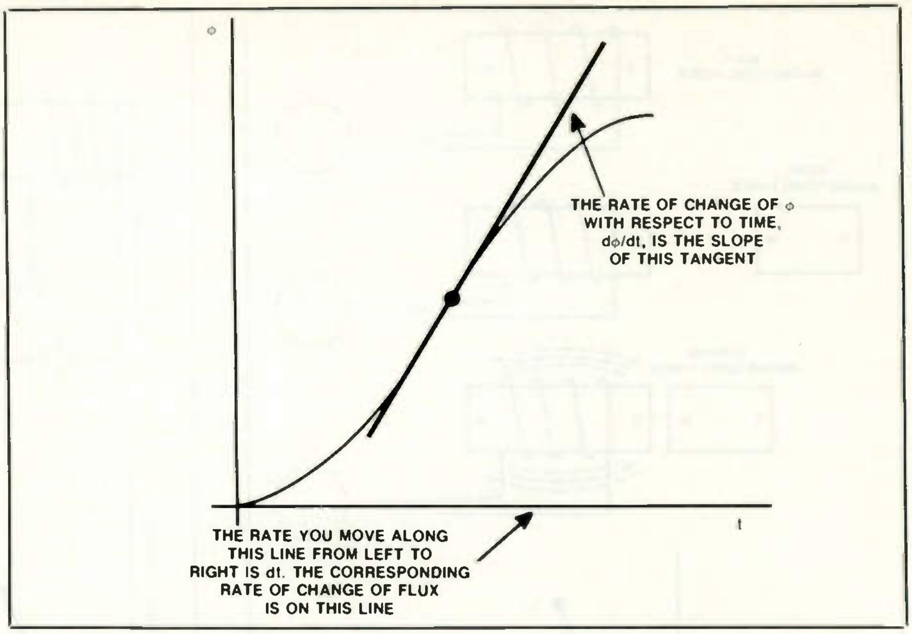


Figure 6.

son. His work on the ticker tape taught him about the inside operations of the stock market and investors.

Once he established the fact that he could invent, he devised a method of getting backing that has never been equaled. His light bulb is a good example of how it works. Long before he could get one to work he announced to the journals that he had actually invented the light bulb. He hinted that he would demonstrate it soon. Investors wanting to get in on this great invention poured money into Edison's "invention."

Once he had the money he needed he got busy and really did invent one. There were some uneasy moments of doubt in the investor's mind, but, invent it he did. The true story of that invention is much more fascinating than the story they sometimes put in the school history books.

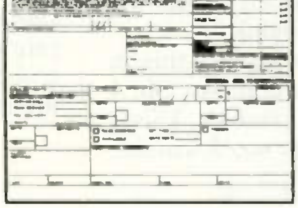
Not everyone was fooled by all that fancy footwork. Scientific American announced that it would not be necessary for "Mr. Edison" to produce inventions. All he had to do was announce that he had an invention and he could live very well on the resulting income.

Well, after all is said and done, he did produce a light bulb.

Let me announce my invention. I have a patent so you can consider me to be in a position of a successful inventor.

You know the problem of sleeping on your side. You never get really comfortable because your arms get cramps. I have invented a mattress with a hole in in that you can put your arm through when you sleep on your side. It comes with a little roller skate for your hand so you don't get rug burns.

Investors can contact me through this magazine. ■



Beware TSR programs

By Conrad Persson

There's a class of programs that goes by the abbreviation "TSR", which stands for "terminate and stay resident." They're wonderful, useful programs that can increase the productivity of the computer user, and make using the computer a whole lot easier. Unfortunately, they're not without drawbacks. These programs can interfere with certain other programs and appear to be causing hardware or software problems. If the computer owner or operator has written an autoexec.bat file that loads them automatically when the computer is turned on and the technician isn't aware that they're there, he may spend hours trying to troubleshoot a problem that really isn't there, but is merely an incompatibility between two programs that are loaded at the same time.

Some of the more popular TSR programs are a calendar, an appointment book, an address book, and a calculator. When one of these programs is loaded into the computer from a floppy or hard disk it just sits in memory quietly until called upon to operate. The method of calling up one of these programs is through the use of a so-called "hot key." As an example, I have an address book program in my computer as I write this. I can use all of the functions of this word processor program and never know that the address book is there, but when I want to check someone's address, or let the computer dial their phone number, I simply press the hot key, or in this case a combination: hold down the Alt key and press the right Shift key. The screen looks like Figure 1 when I do that.

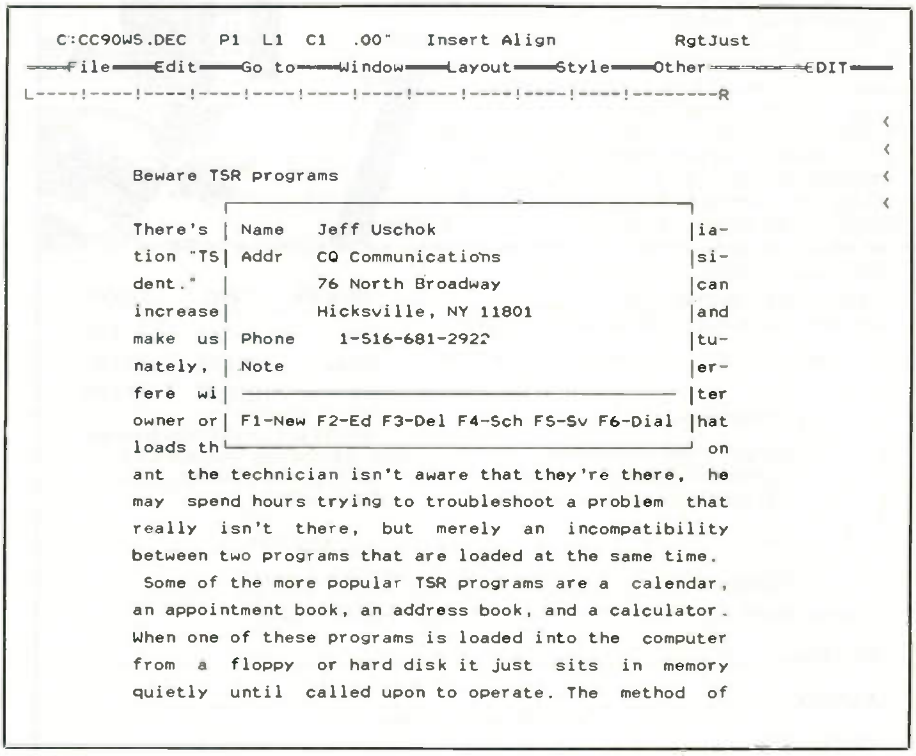
Once this program comes up I can press the F4 key, which allows me to find a particular entry. Pressing Enter repeatedly will step me through all the entries. Entering a name or other string of characters after the word "find" will step me through every entry in my address book that has that string or name in it. F6 dials the number of the current entry.

Fortunately, as far as I have been able to determine, this program hasn't caused me any compatibility problems. Some of the other TSR programs I have, on the other hand have caused problems, and caused me the loss of many hours until I figured out where the problem was. As of this date, I'm not sure exactly which particular TSR program caused the problem because I just haven't had time to experiment.

Some of the other TSR programs I had resident in my computer when the problem occurred were a calendar program and a calculator program. The hot key for the calculator was "Alt-S." When I would press that combination of keys, a graphic that looks like a four-function 10-key calculator pops up, and using the numeric keys and the +, −, *, / and = keys I can add, subtract, multiply and divide. The other TSR program I had resident was a calendar. Pressing the hot key "Alt-C" would bring up the current month's calendar. Pressing the cursor keys would allow me to advance or go back a month or a year at a time. Handy when you wanted to find out what day of the week a particular date fell on during a particular year.

One TSR program that was also available at the time, which I felt would be a very useful one was an appointment book. It's set up to look much like a desk calendar. When you press the hot key it comes up with the current date. You can scroll back and forth through the calendar to record a future event, or review a past event. One of its most useful functions is an alarm. Whether the program is up and running or dormant in memory, the computer will sound an alarm when it's time for an appointment.

The instructions for that TSR program stated that it might be incom-



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L----!----!----!----!----!----!----!----!----!----!----!-------R
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         Beware TSR programs                                            <
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         tion "TS| Addr   CQ Communications              |si-
         dent."  |        76 North Broadway              |can
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         ant  the technician isn't aware that they're there,  he
         may  spend hours trying to troubleshoot a problem  that
         really  isn't  there,  but  merely  an  incompatibility
         between two programs that are loaded at the same time.
          Some of the more popular TSR programs are a  calendar,
         an appointment book, an address book, and a calculator.
         When one of these programs is loaded into the  computer
         from  a  floppy  or hard disk it just  sits  in  memory
         quietly  until  called upon to operate. The  method  of
```

Figure 1.

Persson is editor of **ES&T**.

Test your electronics knowledge

Answers to the quiz

(from page 41)

1. C

2. A

3. Class AB

4. C

5. Position X - – 1.5V
Position Y - 0V

6. See Figure D

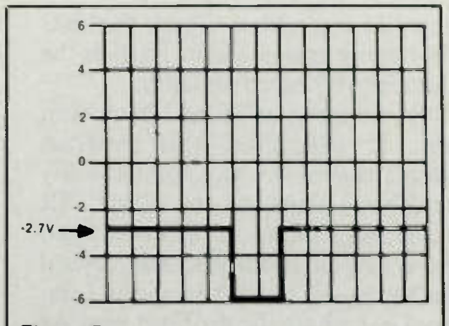

Figure D.

7. first order filter

8. dynamic resistance (also called ac resistance).

9. B - I say again there is no such thing as a bead ledge in electronics. (A bead ledge is used in tire molds.) Thermistors can have either a negative or positive temperature depending upon which you specify when you order one. The temperature coefficient is usually negative.

10. A

patible with some word processor programs, and that specifically it was not compatible with the word processor program I was using at the time. I tried it anyway. It worked fine. Until I pressed Alt in combination with another key (I don't remember which key). Then everything froze up and I had to reboot. I have still never used the program.

The difficult to diagnose problem occurred when I had the calendar and the calculator programs resident in my computer. I tried to use a communications program. It has worked fine on the computer I'm using to write this article. One day I tried to use it at work and it just wouldn't work. I tried changing the communications port in the computer software. No help. I changed parameters in the communications program. No help. No matter what I did, the communications program said it was dialing the number, but I could hear that it never even opened the line.

It never occurred to me at the time that the problem might be with a TSR program. For several days in a row I fiddled with the communications program, even to the point of borrowing someone else's; thinking that somehow my floppy disk had been corrupted. Still nothing.

Finally it occurred to me that the problem might be something resident in the computer, so I booted it up using a floppy disk that didn't contain my batch files that automatically loaded the TSR programs. With nothing in memory but the operating system I loaded up the communications program and it worked like a champ.

As we have written before, any time you're getting ready to service a personal computer, take along a floppy disk with the operating system on it. If there's a problem that doesn't yield easily to your probing, boot the computer with the floppy disk. If the problem goes away, there's a high likelihood that the problem is being caused by something that's being loaded in at startup. Look at the batch files and see if there are any TSR programs that are being loaded that may be causing incompatibility problems with some of the other software.

Books

Encyclopedia of Electronics - Second Edition, By Stan Gibilisco and Neil Sclater; Tab Books; 976 pages; $69.50.

This is the single-source reference available to anyone involved in general electronics. This authoritative new edition contains more than 900 pages of updated information covering every electronics concept and component. There are sections on digital electronics, computers, communications, and integrated circuits, artificial intelligence, bar codes, fax machines, high-definition TV, semiconductors, compact discs and much more. It also includes concepts in physics, mathematics, computer science, and chemistry as they relate to electronics.

Tab Books, Blue Ridge Summit, PA 17294-0850.

Roger Haines on Report Writing—A Guide for Engineers; $22.95.

This book shows engineers how to get their ideas across to any audience, technical or nontechnical. With this guide, readers can produce crisp, concise papers that will leave their intended mark on committees, panels, boards of directors, customers, and even courtrooms. Included you will find how to organize and present material, research information, evaluate data, develop a style for reports, use of graphs, getting the most out of word processing and more.

Tab Books, Blue Ridge Summit, PA 17294.

Electronic Instruments and Measurements: Second Edition, by Larry D. Jones and A. Foster Chin; Prentice-Hall; 580 pages $47.00

This book discusses both service and laboratory-quality instruments, but the major emphasis is on laboratory-quality instruments. Chapter titles include: Introduction to instrumentation, DC meters, AC meters, Potentiometer Circuits and Reference voltages, oscilloscopes, recording instruments, signal generators, transducers, troubleshooting with instruments and an entire section on laboratory instruments. Because obtaining accurate, reliable and cost-effective measurements goes beyond the instrument to the user, this book includes basic theory of operation and considers the capabilities of the test instruments, as well as providing laboratory experiments, in order to strengthen the reader's knowledge of electronic test instruments in order to help him both choose and use them.

Prentice Hall, Englewood Cliffs, NJ 07632; 201-767-5937.

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Troubleshooting digital picture-in-picture

By the ES&T staff

This article was based on the article "Troubleshooting the TA television chassis PCB digital which was published in the October 1990 issue of the Expander by Mitsubishi Electronics America, Inc., Cypress, CA.

As if problems in today's TV sets weren't difficult enough to diagnose with only one picture on the screen, many of the sets being sold these days have picture-in-picture capability. For example, in Mitsubishi's TA chassis, the viewer can invoke many picture in picture modes. Pressing the PIP button on the hand-held remote once produces a separate inserted live picture from an external input. This inserted picture appears in the lower right corner of the screen. If there is no external input, the inserted picture will be a duplication of the main picture.

If the viewer presses the PIP button a second time, the STROBE mode is activated. In this mode, an insert picture appears in each quadrant of the screen. These inserts are time-sequenced still pictures of the main screen picture. These still pictures are updated in a counterclockwise motion around the screen.

Pressing the PIP button a third time activates the CHANNEL SCAN mode. In this mode, the tuning system scans through all channels programmed into the scan memory, and four inserts are produced on a black main screen. Three of the inserts are still pictures of scanned channels, and the fourth insert is a live picture of the current channel. The inserts constantly change as the unit scans through the channels. When the PIP button is pressed one more time, the TV set exits the CHANNEL SCAN mode and remains on the last channel scanned.

Figure 1 is the basic block diagram of the signal processing circuitry on the PCB-DIGITAL. Main picture luminance (Y) and chroma (C) are input to the board at pins 4 and 6 of the SQ connector, respectively. Sub-picture composite video (combined luminance and chroma) is input at pin 2 of the SQ connector.

Sub-picture luminance and chroma are extended from the composite signal by low pass and band pass filters. The chroma is then directed to a Sub-Color Demodulator which generates (R-Y) and (B-Y) color difference signals. The (R-Y), (B-Y) and Sub-Y signals are applied to an analog to digital (A/D) converter. The

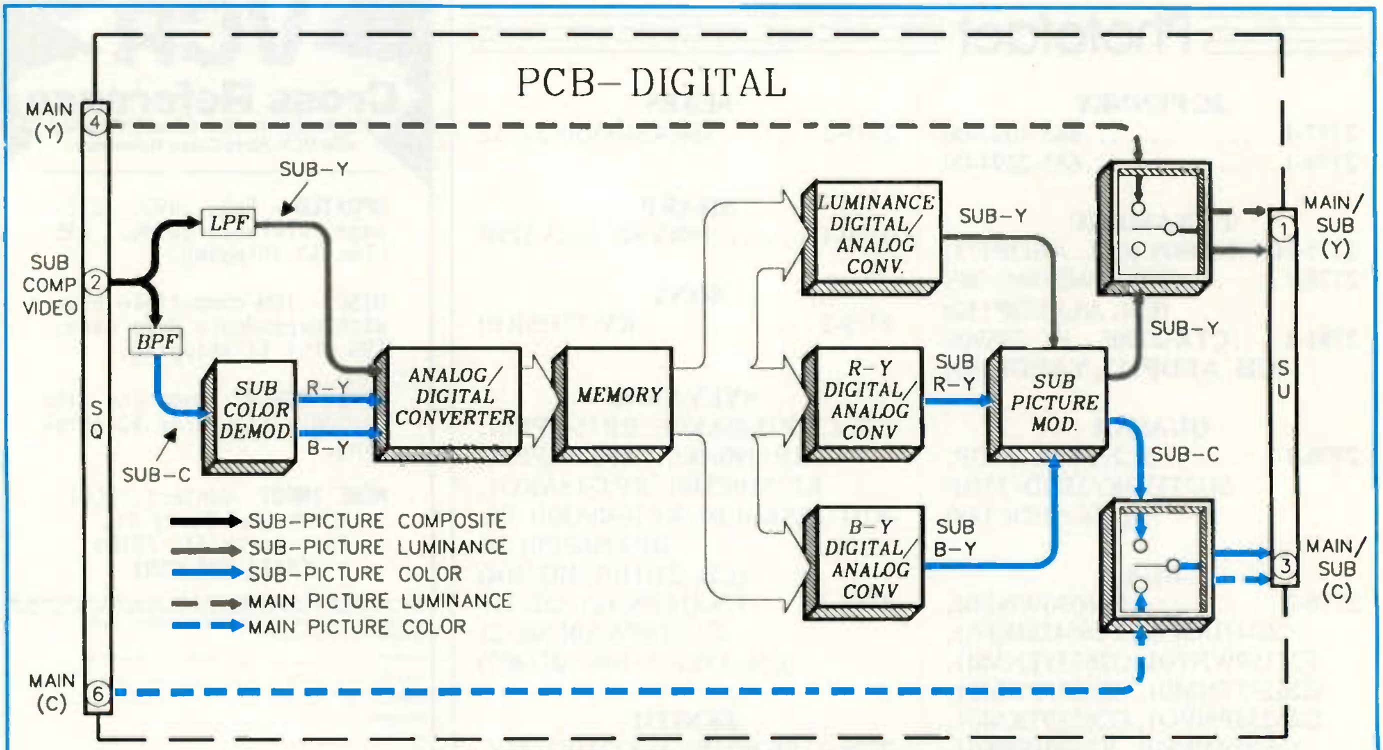


FIGURE 4: PCB–DIGITAL SIGNAL PATH BLOCK DIAGRAM

Figure 1. PCB-digital signal path block diagram.

Symptom	Likely cause
Scrambled insert	• Memory control signals
Insert has wrong skin tones	• Sub color signal source • Color D/A converters
Insert has no luminance	• Sub-Y source • Y-D/A converter
Solid black insert	• D/A converters
Blank fully saturated white or color insert	• A/D converter • Memory
No insert	• Control circuitry

Figure 2. Picture-in-picture problem symptoms and probable causes.

three signals are converted to a 6-bit digital signal and are written into the memory.

The digital signals are then read from memory and applied to three D/A converters, (Y), (R-Y) and (B-Y). The analog outputs of the three converters are directed to sub-picture modulator circuitry which outputs sub-picture (Y) and (C) signals. The sub-picture luminance and chroma signals are directed to separate electronic analog switches. Main picture luminance and chroma are applied to the second contact of the respective analog switches. The sub-picture is inserted in the main picture by precisely timing the operation of the two switches.

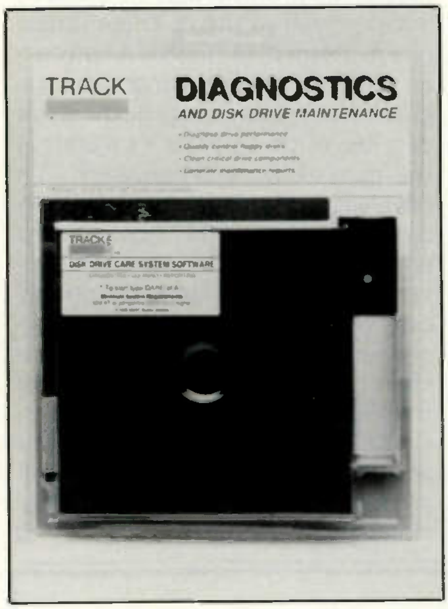
Because the main picture signal is routed through the PCB-DIGITAL, a problem on this board can result in no picture in the normal operation mode. A problem can quickly be isolated to the digital board by checking the input signals at the SQ connector and the output signals at the SU connector.

Isolating PCB-Digital problems

Problems with the sub-picture insert(s) can usually be isolated to sections of the digital circuitry by noting the specific symptom. If the insert is a blank fully saturated with white or color, it points to a problem in the A/D converter or memory circuitry. If the insert has color but no luminance, the problem may be a loss of Sub-Y signal to the A/D converter, or a problem in the (Y) D/A converter. If skin tones in the insert are too green or magenta, it may be the result of a loss of (R-Y) or (B-Y) signals at the input of the A/D converter, or a problem in the (R-Y) or (B-Y) D/A converters. A solid black insert points to a problem in the D/A converters. Picture distortion is usually caused by incorrect or missing memory control signals. Of course if digital modes cannot be activated, the problem is usually in the control circuitry. Figure 2 is a list of symptoms and causes to help you troubleshoot problems in the picture-in-picture circuitry. ■

Utility and data protection system for floppy disk drives

TrackMate introduces the generation 3.0 diagnostic utility and data protection system for floppy disk drives. Software tests disk drives and provides maintenance reports. The system combines an easy to use and easy to understand method of performing and saving basic diagnostic data with safe, effective cleaning of the floppy disk drive. TrackMate's Generation 3.0 software can be used with 3.5" or 5.25" floppy disk drives for MS DOS (PC/AT & PS/2) and compatibles and Apple Macintosh. All software features are menu selected and self tutoring, and can be initiated in either drive A or B.



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New packaging

Meirick Inc announces its changes in technology and packaging for its product line. The Merick 400 remains the baseline unit for PC, XT, AT or PS/2 applications. It will run a typical XT, monitor and dot matrix printer for 15 minutes. It now has a modified sine wave output, RS232 interface, and auto-shutdown software for MS DOS, Unix/Xenix, and Novell. These UPS systems use pulse width modulated output technology, which provides a simulated (stepped) sine wave that allows the computer to operate more efficiently by drawing less power, reducing dc power supply noise and heat.

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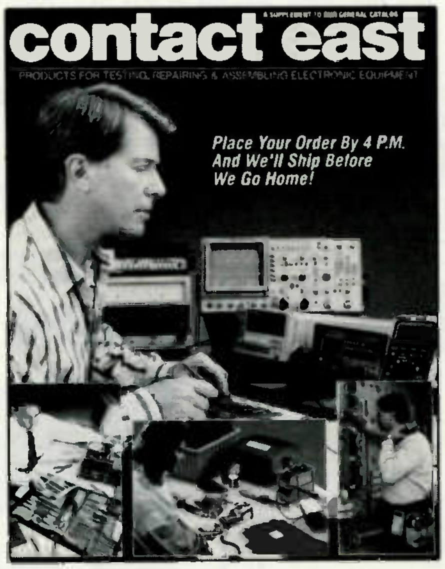
Instrument and tool catalog

Contact East's general catalog comes packed with thousands of tools and test instruments for testing, repairing, and assembling electronic equipment. Featured are brand-name instruments such as Fluke, Leader, Tektronix, Weller, and many more. Product lines are shown in full-color with detailed descriptions, and have been expanded to include new: power supplies, oscilloscopes, soldering equipment, DMM's, EPROM programmers, tone test sets, inspection equipment, light meters, sweep/function generators, tool kits, and much more. All products are fully guaranteed.



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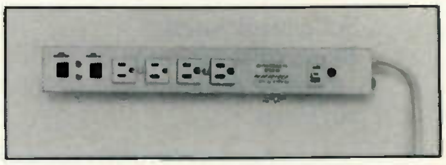

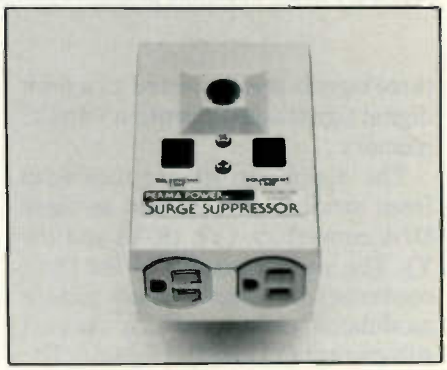

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Tool kit in a vest

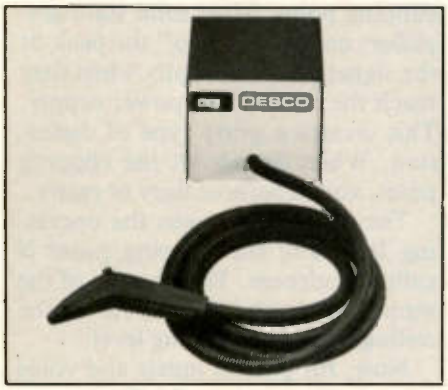
Jensen Tools announces its new tool kit in a vest in design with *Tektronix*. It holds the 4 × 7 × 11" scope (or other equipment) while allowing easy access to front, top or rear panel

controls and connectors. This is a versatile, comprehensive electrical/electronic kit with special application wherever the work done makes it difficult to set tools down. When used as a tool vest, it positions the scope front and center and allows easy access to the tools on a removable top pallet. Fully opened the case becomes a 27" × 13" troubleshooting station with complete access to all tools and computer/power connections on the scope. The JTK-20 features a 12 × 13 × 5" Cordura zipper case with three outside pockets, web-strap handles, and adjustable shoulder strap with shoulder and neck pad.

Circle (18) on Reply Card

Neutralizing air nozzle

New from *Desco Industries* is a neutralizing air nozzle designed to blow ionized air to clean parts or for other operations. A balanced flow of positive and negative ions is created in the nozzle to quickly neutralize charged objects. Dirt, dust and other particles can be removed from charged surfaces such as plastics, at the same time neutralizing any static charges that might be present. Static charges can also be removed from processed parts and materials. Features include integrated power supply, safe, non-nuclear operation, lightweight molded polyurethane nozzle with thumb-operated On/off, adjustable airstream and standard 115V ac power equipment and uses only 35 watts in operation.



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IBM service management system/2

IBM's electronic service management is a new software offering for small-to-medium sized independent consumer electronics service centers. It is designed to be easy to use, even for those with little computer experience. The system runs on the IBM PS/2 or IBM PCs. Service Repair Centers will communicate with manufacturers via the IBM Information Network. A modem is necessary for communications. The system features a full range of applications:

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Computer requirements include IBM PS/2, PC/AT or PC/XT with 640K memory and using DOS 3.3 or later. Also needed is a hard disk-drive with 4 megabytes. Will also be offered in a singer user/PC and in LAN version for multiple users.

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Audio headroom and dynamic range

By John Shepler

Ever wonder why it takes a 75 watt amplifier to make classical background music sound good? Few people ever turn the volume control more than a third of the way up, yet audiophiles routinely insist that only amplifiers with dozens or hundreds of watts can do justice to the music.

The answer has to do with the nature of audio itself. We tend to think that what comes out of a sine wave generator is audio in its purest form. This is only partially true. A sine wave does represent a pure tone. But few instruments and no human voices produce anything near a pure tone.

Tones are for reference. They are useful in tuning musical instruments and tracking down anomalies in electronic circuits. What they don't do is give a good representation of natural audio signals, such as voice and music.

For instance, a customer brings you an amplifier that "sounds bad." You hook it to a load resistor and scope and feed in a sine wave. The output sure looks like a sine wave. Through headphones, the tone is loud and pure. Yet, if you feed a CD player through the same amp and listen through the same phones at the same level, the music will have a gritty edge to it. Technically, the amplifier is distorting.

Figure 1 shows what is happening. Every audio device is designed to run at a particular reference setting, called the operating level. Input and output specs relate to this level. For most equipment it will be somewhere between 0.1 volts and 1 volt. Feed in a tone and the meters or light bars will show a normal indication when you have the volume set to the operating level.

The operating level only represents an average signal, like the test tone. But looking at voice or music on a scope shows that the signal is anything but average. The signal is a complex mixture of the various voltages and frequencies that make up the audio. At a given instant the voltage may be anywhere within the range of microvolts to volts.

Every signal is limited in its range, often called the dynamic range. The smallest signal level is determined by the inherent noise of the amplifier. This is called the noise floor, and is the hiss you hear when you turn up the amp.

The largest signal level is determined by the limits of the circuitry. The point at which the amplifier can no longer faithfully reproduce the input signal is called the overload or clipping point. Most solid state amplifiers cut off or "clip" the peak of the signal rather abruptly when they reach the limit of the power supply. This creates a gritty type of distortion. When signals hit the clipping point, voices become lispy or raspy.

The distance between the operating level and the clipping point is called headroom. The "head" of the signal can extend only as far as the ceiling set by the clipping level.

Now, for perfect music and voice reproduction, at least 20 dB of headroom is needed. The conversion factor between dB and volts or watts can be found in any audio handbook. Some quick rules of thumb are that 20dB equals 10 times the voltage or 100 times the power.

It is easy to see that if you want to preserve those peaks, you must have a 100 watt amplifier that is running at only 1 watt RMS. If you are willing to settle for a little distortion, you can get by with a 10 watt amplifier.

For an amplifier that sounds distorted, look at the peaks of the waveform on the scope. If they are being squared off, you have a headroom problem in the amplifier. A bad chip or a low power supply can easily cause this. Don't get fooled by simple tone tests that fail to show how distortion can be caused by a lack of headroom for the audio. ■

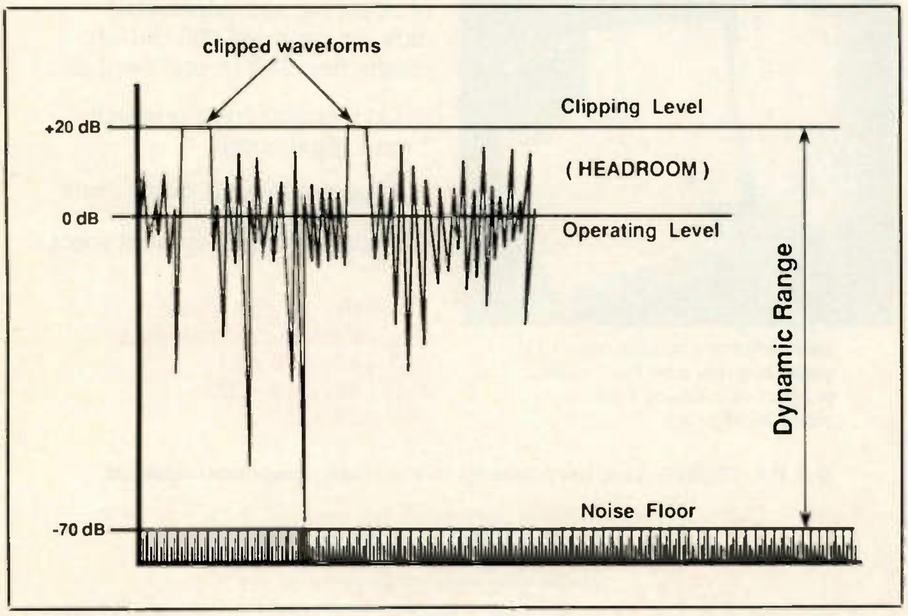

Figure 1.

Shepler is an electronics engineering manager and broadcast consultant. He has more than twenty years experience in all phases of electronics.

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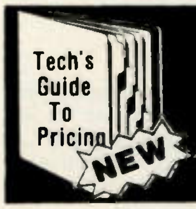

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