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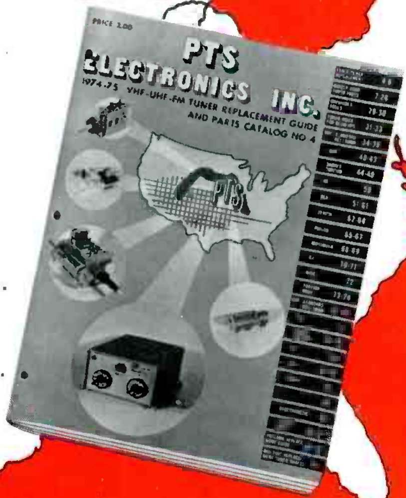

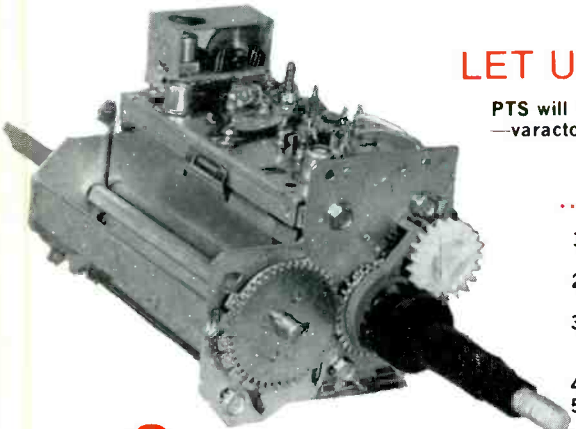

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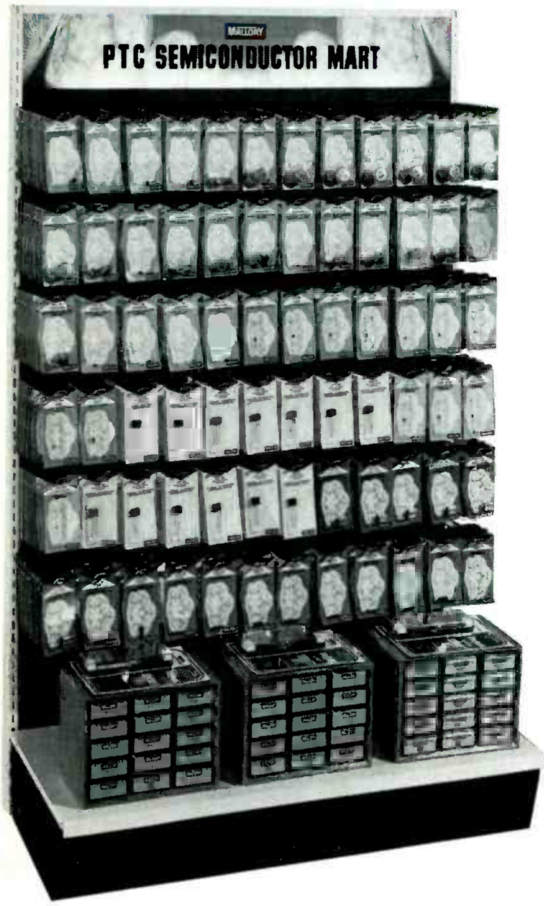

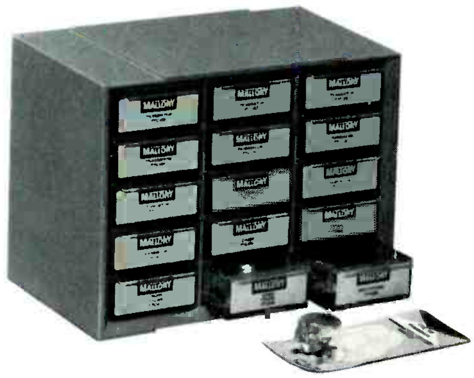

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ELECTRONIC
TECHNICIAN/DEALER

MARCH 1975 • VOLUME 97 NUMBER 3

THE COVER: This photo, by ET/D Staff Photographer Karen Steklasa, symbolizes the direct relationship between efficient service-call dispatching and profitability.

FEATURES

DEPARTMENTS

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LETTERS

PARTS AND SERVICE FOR IMPORTED, PRIVATE- LABEL PRODUCTS

Following is an example of a problem that continues to plague many service shops:

We recently had a customer bring in an imported, private - label, 18 - inch, "portable" color TV receiver which we had never heard of or seen before. It is not covered in TEKFAX, Photofacts or any other type of service data. We inquired about it at a few other shops in our area, even one which specializes in imported sets, but no one knew anything about it.

We finally were directed to Sterling Hi - Fi Company in Long Island City, New York, who, in turn, directed us to American General Supply, 8320 Grenache, Ville D' Anjou, Quebec, Canada. Our phone conversation with American General Supply:

"Do you have a schematic for the AGS Model 930CT color TV receiver?"

"No."

"Do you know where I can get a schematic or do you have a dealer or service center in the U.S.?"

"No."

"Is anyone there familiar with the chassis in this receiver?"

"Yes, I think so. Hold on a minute...Yes, we have someone who is familiar with that chassis. What is the problem?"

The result of this lengthy, and expensive, phone conversation was that they agreed to send us a photocopy of a copy of their photocopy of the schematic. It seems that they do not have parts or service data for any product that has been on the market for more than five years.

So here we sit, waiting for a schematic for a TV receiver for which we probably will not be able to get a replacement part (in this case, the flyback).

Yet, we servicing dealers cannot convince many consumers that a color TV priced at $199, and for which service data and parts *cannot* be obtained, is *not* really a bargain compared to a $299 TV for which service data and parts *can* be obtained.

Henry B. Ruh
Communications Unlimited
Whitmore Lake, Michigan

Mr. Ruh, as you seemingly are aware, there probably will always be consumers who are more price conscious than value conscious, and there probably will always be "dump - and - run" entrepreneurs who are more than willing to serve the needs of this "bargain" - oriented market. For this reason, servicers will continue to encounter products for which service data and parts are not readily available.

In my opinion, the wisest approach to this problem is to courteously decline to service such products. Because it is almost impossible to make a reasonable profit, if any at all, from the repair of these products, I can see no sound *business reason why any servicer should attempt to repair them. Most consumers who buy these so - called "bargains", will also be looking for a "bargain" when it comes time to pay for servicing them.*

I doubt that refusal to repair such products will completely eliminate them from the market, but, at least, it will eliminate them as a problem for servicers.–The Editor

THE USE OF PIGGY-BACK FUSE CLIPS

Why do the manufacturers who use pigtail fuses criticize technicians for using piggy - back fuse clips? There is less chance of the fuse clips I use shorting than of pigtail fuses shorting.

Fuses are, by nature, intended to be replaced. Why should they be soldered in?

Harvey Kreiman
Anaconda, Montana

There are two general types of so - called "piggy - back" fuse clips: One type consists of exposed, "S" - shaped clips which are not insulated *and, consequently,* do *create additional shock and shorts hazards. The other type consists of "S" - shaped clips enclosed within an* insulated *"cage", so that neither the clips nor fuse create additional hazards.*

I personally see no reason why manufacturers should object to the use of the insulated type of piggy - back, but I can *understand their objection to the use of the exposed type. And don't forget, their liability ends where* your's *begins.*

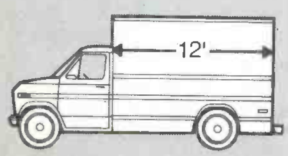
The principal reason that some fuses are soldered in is that it saves the manufacturer the purchase price and the cost of mounting the fuse holder.
–The Editor. ■

MOVING?

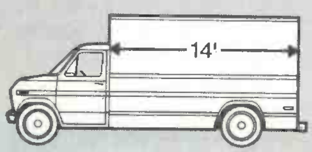
Be sure to let us know your new address. Please enclose a complete address label from one of your recent issues.

New capacity to 10,725 lbs. GVW

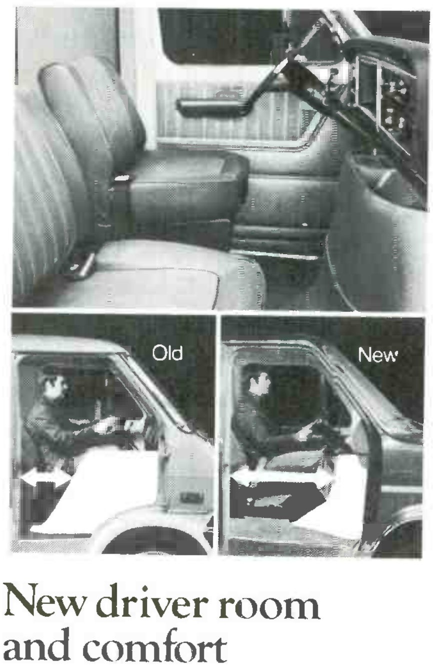
Now you can consider compact Ford Parcel Vans for jobs previously too big or too heavy for this type of truck. New 14-ft. body is 8 ft. wide, offers 40% more cube than Ford's biggest '74 model. GVW's to 10,725 lbs. boost payloads, too. For easy loading, hinged rear doors are almost body wide. Doors swing open all the way against body sides...have slam-shut latches, provision for locking. Options include roll-up doors, cab partitions with or without walk-thru, roof vents, rub rails.



12-ft. body has 138 in. wheelbase. It's 7 ft. wide on E-250, 8 ft. on E-350.



14-ft. body has 158 in. wheelbase. Body is 8 ft. wide, has 6'2" headroom.

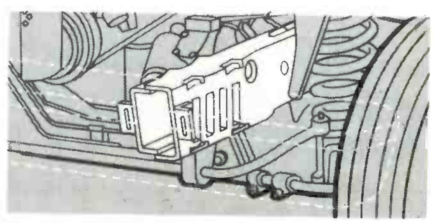


New driver room and comfort

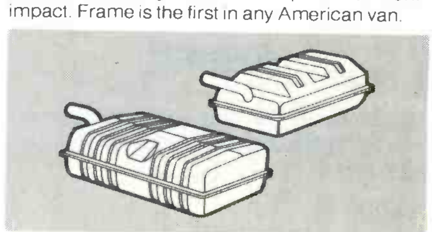
Ford gives the driver what he needs to get more done with less effort. Big, wide cab doors make getting in and out easy. Because the engine is forward out of the way, driver can easily step back into the load area—or across to the curbside cab door. Both driver and helper have good legroom and footroom. Thick, insulated engine cover has handy pockets on top.

New durability engineering

Separate chassis with frame, the only American van with this construction, provides a strong foundation for the entire vehicle. Frame rails are designed to help cushion impact from the front. To resist corrosion, key components are galvanized and the entire cab is primed by deep-dip Electrocoat. These vans are built to keep their value. Cruise-O-Matic, power front disc brakes, 300 Six are standard.



Energy-absorbing frame rails help cushion front impact. Frame is the first in any American van.



Standard and auxiliary fuel tanks are located between the frame rails, total up to 42.6 gallons.

NEWS OF THE INDUSTRY

Home Video Disc Players Might Enter Market This Year

The fact that two major developers of optical - scan disc video players — MCA and Philips — have come to terms on an agreement to cooperate in developing standards for compatibility of their systems could mean that home video disc players will appear in home entertainment dealers' stores in limited quantities by the middle of this year, according to a recent report in *Mart* magazine.

However, as the *Mart* report pointed out, the optical - scan system of MCA, Philips and others, who are committed to this type of video disc system, will have to do battle with RCA's *SelectaVision* video disc system, which employs a mechanical - capacitance pick - up device that seemingly is incompatible to any existing type of optical - scan system.

RCA, whose *SelectaVision magnetic* tape video player/recorder has undergone limited testing in the Indianapolis area but has not been marketed, has kept its video *disc* system under wraps except for private showings to prospective licensees, one of which reportedly is Zenith.

According to the *Mart* report, the retail price of a video disc player is expected to be under $500, and pre - recorded video discs will sell for as little as $2 for a 10 - minute program and $10 for a 90 - minute feature film.

Total TV Sales To Dealers Down 15.5 Percent In 1974

Although total unit sales of TVs to dealers in 1974 were 15.5 percent below the record TV sales achieved in 1973, and total unit sales of *all* categories of consumer entertainment electronic products in 1974 were down 11.8 percent from 1973 sales, 1974 still ended up as the third best year the consumer electronic industry has experienced to date.

These and other unit - sales comparisons between 1974 and 1973 are revealed by the following statistics, which were compiled and recently released by the Consumer Electronics Group of the Electronic Industries Association:

TOTAL U.S. MARKET STATISTICS
SALES TO DEALERS
FINAL FOR YEAR 1974
(In Units)

	TOTAL YEAR 1974	TOTAL YEAR 1973	% CHANGE
TELEVISION			
Monochrome	5,940,823	7,032,793	−15.5
Color	7,829,554	9,263,503	−15.5
TOTAL TELEVISION	13,770,377	16,296,296	−15.5
RADIO			
AM	12,903,291	16,923,558	−23.8
FM	20,055,482	18,846,503	+ 6.4
TOTAL	32,958,773	35,770,061	− 7.9
AUTOMOBILE	10,761,760	12,471,677	−13.7
TOTAL RADIO	43,720,533	48,241,738	− 9.4
PHONOGRAPH			
Portable & Table*	4,428,311	5,673,316	−21.9
Console	837,189	922,758	− 9.3
TOTAL PHONOGRAPH	5,265,500	6,596,074	−20.2

*Includes compact and component systems.

Shorter TV Labor Warranties A Reality

RCA and Sylvania have reduced their labor warranties from one year to ninety days on some color TV receivers in their 1975 product lines. There are unconfirmed rumors that by the new model year, in June, other major TV manufacturers will join the switch from one - year to ninety - day warranty labor.

BRH Orders Recall of Nearly 300,000 Color TV Receivers

Almost 300,000 solid - state color TV receivers sold under various brand names, including Panasonic, Bradford and Penncrest, have been ordered recalled by the U.S. Bureau of Radiological Health (BRH) on the grounds that component failure in the horizontal output and high - voltage systems of these receivers could lead to the emission of excessive radiation.

The recalls involve about forty models of solid - stage color TV receivers, with screen sizes ranging from 9 to 25 inches (diagonal). ■

Service back-up

Quasar's back-up programs are designed to help our thousands of authorized servicers keep their customers happy.

We design Quasar TV serviceability with you in mind. Our own service experts are, in fact, involved in design at the drawing board stage. Their contributions help you perform your job more professionally to help enhance your image with consumers. Such keen awareness of your needs helped lead to our pioneering in modular chassis concepts.

Our regular, practical training helps keep you up to date. Quasar's 83 distributors conduct thorough training seminars regularly to acquaint servicers with newly-introduced products and to pass along updated servicing techniques. Quasar even provides practical, valuable service literature regularly for a nominal subscription fee.

Our speedy PACE parts availability system helps you maintain customer good will. To help you satisfy most consumer problems promptly, yet help keep your shop inventory reasonable, Quasar offers its PACE program through distributors. Using this optional program, the distributor can stock 90% of all parts you'll ever need. Beyond that, we'll drop-ship through our distributors from the factory direct to you.

A new company with new solutions for today.

Quasar Electronics Corporation

A subsidiary of Matsushita Electric Corporation of America

...for more details circle 130 on Reader Service Card

ELECTRONIC ASSOCIATION DIGEST

Information about the activities of national, state and local associations of electronic servicers, dealers and manufacturers. Material for publication in this department should be addressed to: Service Association Digest, ET/D, 1 East First St., Duluth, Minn. 55802.

EIA's Service Technician Development Program To Continue In 1975

The Consumer Electronics Group (CEG) of the Electronics Industries Association (EIA) recently announced that it had launched a $250,000 public service program for 1975. Included in this program is CEG's Service Technician Development Program (STDP), which it started seven years ago.

The purpose of the STDP program is to attract, prepare and place people in careers as electronic service technicians, to insure continuing reliable service of consumer electronics products. The STDP involves five separate activities: teacher training and upgrading, textbooks, career guidance, minority training, and technician image improvement.

In the 1975 CEG Service Technician Development Program, a number of university - level teachers will be taught electronic service training techniques developed by the CEG. Then, in 21 summer seminars held throughout the country, the university - level teachers will teach these training techniques to over 500 high school vocational and industrial arts teachers, who, in turn, will use them in the training of over 25,000 students during the 1975 - 1976 school year.

The locations for the summer seminars are selected from among the 42 market areas that presently account for over 50 percent of the country's total consumer electronics service volume. The 21 locations are selected from among these 42 market areas on the basis of service volume, availability of a suitable site, and attendee drawing potential.

In addition to teacher training, the CEG will provide schools with grants and special discounts for purchasing new solid - state color TV receivers used in the CEG - developed training program.

Two - hundred and forty prints of CEG's electronics career film title "Futures Unlimited" will be circulated to schools through Association Sterling Film distributors, and 10 prints of the film will be circulated among television stations, for public - service airing. (Over one million students and five million television viewers have seen the film to date.)

Electronics career guidance brochures, over 1,500,000 of which have been distributed to students and parents to date, will continue to be available, along with CEG's brochure which lists schools presently offering consumer electronic service training. The school list is sent to students who request career information. (Each week during the school year, the CEG staff receives and processes an average of over fifty requests for career information.)

CEG has developed a comprehensive program for training minority and disadvantaged youths in electronics.

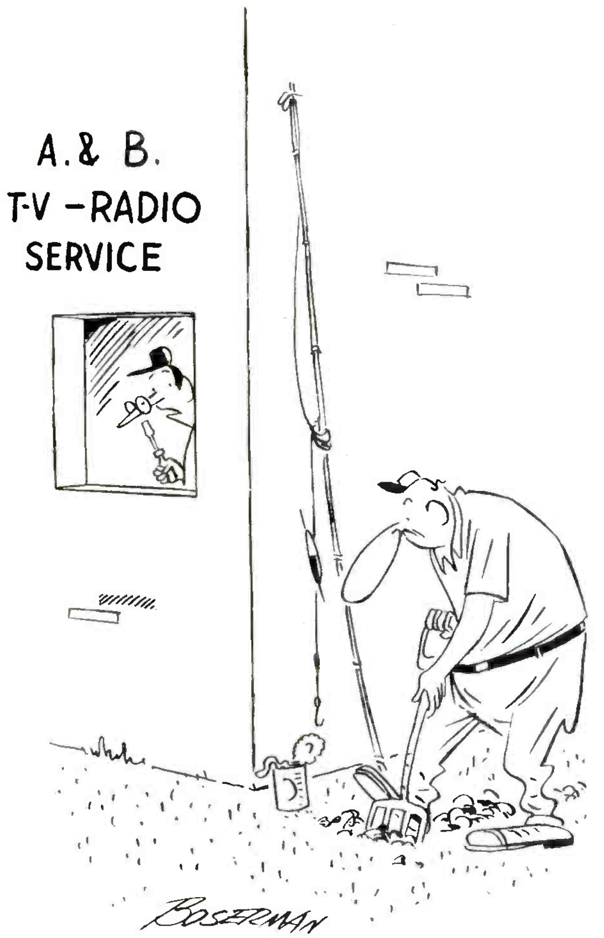
In addition to developing and testing the program, CEG is sponsoring a series of training classes in downtown Detroit; Hickory, North Carolina; the South side of Chicago; and in New York City. (Three new sites will be added during 1975.) CEG's sponsorship includes help with the curriculum and the supplying of textbooks and training aids; help in picking and training instructors; supplying of consumer electronics products and test equipment needed for the training program; and placement of graduates of the program.

CEG currently sponsors thirteen textbooks and lab manuals for use in consumer electronic service training. The original series was developed by CEG in 1952 and has been continuously updated since then. A crash program is now underway to update the series so that it will accommodate new servicing techniques related to the newest all - solid - state, modular designs of consumer electronic products. In addition, the CEG has outlined and is presently reviewing author credentials for a new series of diagnostic texts covering field servicing.

In 1975, CEG also will present STDP displays at the annual conventions of the American Vocational Association and the American Industrial Arts Association, to acquaint high school teachers with CEG's training programs, textbooks and other training aids.

NATESA Given List of TV Shop OSHA Violations

The director of Region 5 of the Occupational Safety and Health Administration (OSHA) has provided the National Alliance of Television and Electronic Service Associations (NATESA) a list of the OSHA violations found most recently in TV shops in that region. Included on the list were: National Electrical Code Violations, including ungrounded power tool cords, open junction boxes and exposed "live" circuits; violations related to the safety of grinding wheels; lack of separate facilities for employees of both sexes; failure to display an OSHA poster; lack of or inadequate fire extinguishers; failure to maintain log of accidents; uncovered waste cans; insufficient aisle space; lack of provisions for first aid; and lack of personal safety equipment. ■



"Boss, what are you going to do about those parts on back order with no prospect of delivery in sight?"

TECHNICAL LITERATURE

FM Two-Way Radio Course

An 8 - page pamphlet describing their newly revised home study course is now offered. The booklet outlines the contents of the 40 lessons and 13 reference texts included with the course. The MTI correspondance course covers professional FM two - way radio from the service technicians' point of view. *Motorola Training Institute,* College Hill Road, Summerdale, PA. 17093.

Audio Products Sales Aides

A new booklet, "The Basics of Audio Selling" is now available. The vest pocket - size booklet helps every dealer whether he is a novice in the audio retailing or a veteran. The booklet contains selling philosophy and actual case histories. The idea behind the booklet — a segment of a larger dealer support campaign — is to supply dealers with basic ideas to increase their sales effectiveness. *Altec Corporation,* 1515 S. Manchester, Anaheim, CA 92803.

Electronic Supplies and Accessories

A new 1975 catalog of electronic supplies and service is now available. The catalog is geared towards the electronic organ field, but can be used in the audio or TV field. The catalog lists semiconductors, resistors, switches and controls, vacuum tubes, fuses, chemicals, soldering irons, heat guns, test equipment, capacitors, and organ covers. Also listed is the repair services available on transistor tone generators for most organs. *Barry Kamen, Piano Co.,* 73-15 Yellowstone Blvd., Forest Hills, N.Y. 11375.

Heathkit Catalog

A catalog describing Heath's selection of electronic kits is now available. A new series of small - screen color TV's featuring on - screen digital channel and time readout joins the lineup of color and B/W TV. There are over 350 kits described in the catalog, for virtually every do - it - yourself interest. *Heath Company,* Benton Harbor, MI. 49022.

Digital Instrument Course

The first two parts of a comprehensive course in digital techniques, called the "Digital Instrument Course," is now available. Used by Philips technical personnel around the world, the course offers an in - depth understanding of digital circuits and the mathematical theory behind them. The digital instrument course is divided into five parts: 1) Basic Binary Theory and Logic Circuits; 2) Digital Timers and Counters; 3) Digital Voltmeters; 4) Data Logging in Small Systems; 5) Automatic Measuring Systems. Starting with a detailed instruction of number theory and Boolean Algebra, the course progresses through digital blocks and circuitry right up to data communication and control. Both Digital Instrument Course, Part I, a 60 - page soft cover book, and Digital Instrument Course, Part II, a 64 - page soft cover book, are each available for $3.50. The price includes postage and handling. New York State residents should add 7% tax. Publications Department, *Philips Test & Measuring Instruments, Inc.*, 400 Crossways Park Drive, Woodbury, NY. 11797.

How To Extend the Frequency Range Of Hewlett-Packard's Signal Generator

With a do - it - yourself circuit, described in a new Application Note, No. 171 - 2, from Hewlett - Packard, the familiar HP Model 8640A and 8640B Signal Generators' frequency range may be extended downwards to DC. It shows how to build a simple external heterodyne circuit with common stock parts to do the job. The range is useful for many lower IF frequencies and some audio circuit work, for those who already have the unit in - house. Inquiries Manager, *Hewlett - Packard Co.*, 1501 Page Mill Road, Palo Alto, CA. 94304.

Tape Player Parts

A new 48 - page Tape Player Parts Catalog, No. 5, is now available. This catalog features the wide range of parts available from PTS Electronics, Tape Player Part Division. Eight - hour tape recorder service is now available on 8 - track cassette, mono, stereo, quadrasound, car or home tape equipment. *PTS Electronics, Inc.*, P.O. Box 272, Bloomington, IL. 47401.

Picture Tube Product Guide

A revised product guide PIX - 300H describing RCA picture tubes for the renewal market is available from *RCA Electronic Components*. This guide includes an interchargeability directory that lists RCA replacements for 975 industry types including over 85 foreign types. The characteristics charts contain data on all types where RCA has a replacement. The product guide also includes basing diagrams, pictorial views illustrating the various safety feature constructions, and keys to tube sizes in the old, new, and foreign type designation systems. *RCA Electronic Components*, Commercial Engineering, Harrison, NJ.■

The van that's worked

Dodge Tradesman.

CHRYSLER
MOTORS CORPORATION

its way to the top.*

And here are 22 hardworking reasons why it'll stay there.

1. Smaller 6 and V8 engines. Dodge is very big on a couple of small engines. The 225-cubic-inch Slant Six. And the 318-cubic-inch V8. Both have plenty of power and make it on very little gas. (And they're smaller than any engine Ford or Chevy's got.)

2. Great fuel economy. Tradesman's gas-sipping Slant Six will give you a real run for your money. In recent EPA tests, it went farther on a gallon than any other van. In stop-and-go city driving or out on the open road, you can count on Tradesman to go easy on the gas.

3. Big standard fuel tank. Dodge gives you a standard gas tank that holds 23 gallons. (Chevy's tank holds only 21.) If you really want to fill 'er up, you can opt for our big 36-gallon tank.

4. Easier side loading. Tradesman lets you take in business on the side with a standard side door that's a big 49¼ inches wide. (Bigger than either Ford's or Chevy's.) And because our passenger seat's in an out of the way place, there's plenty of room to load cargo, too.

5. Lighter curb weights for payload. Dodge Tradesman weighs less and can carry more than either Ford or Chevy. On comparable models, it weighs 524 pounds less than Ford and 140 less than Chevy. With Dodge Tradesman, you go in weighing less, so you can come out carrying more. It's as simple as that.

6. Better maneuverability. Tradesman's easy handling and compact size let it literally run rings inside Ford and Chevy. Curb to curb, its turning diameter is over three feet shorter than either of them. So, you can U-turn a Tradesman without a lot of backing and filling.

7. B300 short wheelbase. With a Tradesman B300 (short 109-inch wheelbase), you can jockey up to a ton of stuff into tight areas that a van with a longer wheelbase couldn't get into. So you can take care of all the little ins and outs that a Ford (138-inch) can't.

8. In-cab hood release. It keeps strangers from poking around in your engine. Once you've locked your doors, you've locked your hood, too. (And it's an option that only Dodge has.)

9. Biggest van in the business. With 18 extra inches of overall length, the Dodge Maxivan is the biggest van on the road. You can count on Maxivan to handle all the big stuff that other vans can't even close their doors on.

10. Smaller standard tires. Because Tradesman weighs less than any other van, it can go on smaller tires, too. (Tires that could save you up to 40 bucks at replacement time.)

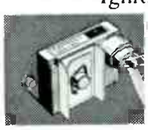
11. Wide choice of engines. With Tradesman, you've got three engines to choose from on every model. There's a thrifty 225 Slant Six (plenty of power but economical, too). A 318 V8. Plus the muscle of a 360 V8.

12. Automatic speed control. Tradesman's optional automatic speed control makes it easy to take it easy. Cruising at a constant speed not only saves on gas, it saves on the driver, too. (Available on both Dodge V8's, but only on Ford's biggest V8.)

13. Single rear door. Tradesman's optional single rear door has a big panoramic rear window. No one else has it. (Standard are two swing-out doors.) What about getting in and out on the side? You can go with our swing-out doors. Or you can opt for one that slides.

14. Air conditioning. More than likely, a lot of long hard days are also going to be long hot days. So, you can opt for air conditioning on every Tradesman model. (But not on every Ford.)

15. Proven Electronic Ignition. When it comes to Electronic Ignition, Dodge was off to a fast start years ago. Today, we've got the kind of proven performance you know you can count on for surer starts and fewer tune-ups.



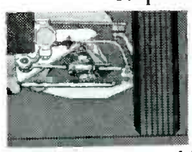
16. Glove box. Dodge gives you a car-style glove box (with an optional door) in the instrument panel. In Ford and Chevy, the glove box is only a bin in the engine cover.

17. Auxiliary rear heater. Dodge offers an auxiliary rear compartment heater on every Tradesman model. (Chevy doesn't have one at all. And Ford's 124-inch WB doesn't have one either.) So with Tradesman, working in back is a lot nicer in cold weather.

18. Largest selling van chassis. Look underneath most mini motor homes and you'll find a Dodge van chassis. (It supports more families than anyone else in America.) And it comes with great features such as "Thumpless" tires, a choice of either 127- or 145-inch wheelbase, and a maximum GVW of 10,500 pounds.

19. Larger parking brake linings. Dodge has beefed up its parking brake linings (they're bigger than Ford's). Because the bigger they are, the longer they'll last. Which means less money to shell out for replacements.

20. Easier front wheel alignment. Dodge's independent front suspension gets the bumps before they get you. But sooner or later, the bumps get to any suspension. On a Dodge, realignment's an easy matter. Not so on a Ford. Their suspension can't be realigned on anything but special (and sometimes hard-to-find) truck alignment equipment.



21. Lower overall vehicle height and shorter length—garageability. Tradesman is more compact than Chevy, and up to a foot shorter than Ford. And that can mean a lot when you're short on space. Especially if you've got more than one van.

22. Standard two-stage front door check. Dodge has put a stop to slamming doors. In two positions. If you're in a hurry, check the door half-way. If you're lugging a load, Tradesman's doors will open wide. And stay there.

Dodge Tradesman. You'll get a lot of business out of it because you get so much in it.

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Dodge

Dodge Trucks

*Based on R. L. Polk's 1974 model year retail registrations for Tradesman vans and van chassis.

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Efficient Service–Call Dispatching

By J. W. Phipps

Minimizing travel time decreases costs, increases technician productivity, makes possible more competitive pricing, and boosts home-call profits.

THE NEED FOR EFFICIENT DISPATCHING

■ A wise and witty service shop owner recently remarked that not long ago, but almost too late, he had finally realized that he could no longer afford to provide home service calls on a "gourmet" basis at "cafeteria" prices.

Prior to his realization that efficient service - call dispatching is an essential factor in profitable and competitively priced home calls, he had been scheduling and assigning service calls to his technicians on a basis that made no allowance for the *location* of the call. As a result, technician A was making a service call in the afternoon in the same area in which technician B had made a call that morning. Also, because he had no established procedure for verifying beforehand whether or not a customer was home, his technicians were encountering an excessive number of "not at homes." In addition, his shop storage area was overflowing with completed in - shop - repair items because he "just couldn't seem to schedule their delivery in between the daily service calls."

Although his home - call technicians seemed to be busy most of the time, he still couldn't realize a reasonable profit from the home - call segment of his business. And to make matters worse, to realize even the meager profit he was getting from his home - call business, he was forced to charge a higher service - call rate than any other shop in his operating area. And he had begun to detect a slight loss of business as a result of his uncompetitive pricing.

Then, in a discussion about home servicing during a service association meeting, he learned that the number of service calls his technicians were averaging per day was significantly less than that being achieved by most other shops in his area. This bit of comparative information prompted him to begin a more methodical analysis of his home - call problems. From this analysis, he finally concluded that, because of inefficient scheduling and routing of service calls, his technicians were being forced to travel excessive distances between service calls. This, in turn, increased his vehicle operating and maintenance costs and, at the same time, reduced the productivity of his technicians by forcing them to spend an excessive amount of time each day behind the steering wheel. The more time his technicians spent driving each day, the lower the number of calls they were able to make.

The effect of these two principal factors, both of which were *directly related* to the *average distance* his technicians were traveling between calls, was to increase the amount that it cost *him* to produce a service call. Consequently, to maintain even a meager margin of profit, he was being forced to charge an uncompetitively high service - call rate.

The witty, and now even wiser, service shop owner had finally

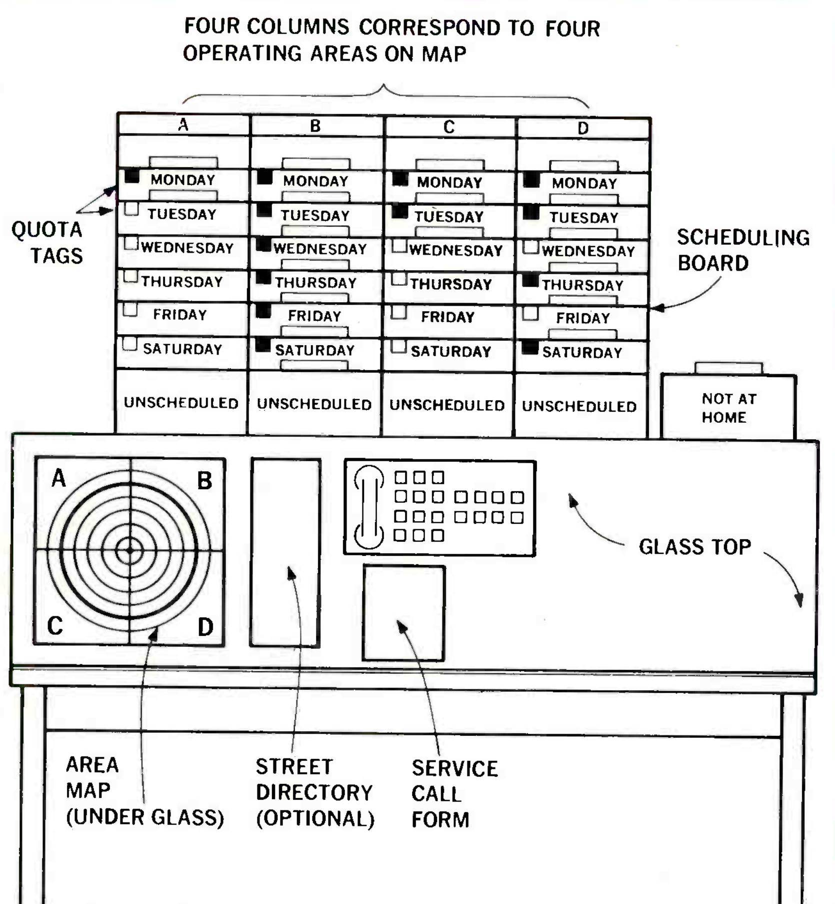

Fig. 1—Typical home - call dispatching center, with essential elements and features pointed out.

come to the realization that, if his home - call rate was to become (and remain) both profitable *and* competitive, he must implement an efficient home - call dispatching system which schedules and routes service calls on a distance - saving, and consequently time - and cost - saving, basis, but yet insures completion of calls within a time frame acceptable to most customers.

The fundamental principals of the home - call dispatching system he implemented to solve his scheduling and routing problems are illustrated in the following basic system.

THE BASIC SYSTEM

The key elements of an efficient home - call dispatching system are illustrated in Fig. 1. They are: 1) a scheduling board; 2) a segmented map of the service area; 3) a multi - line phone; and 4) a pad of service - call forms. The only other essential "tool" required but now shown in Fig. 1 is the human - type call - taker/dispatcher (your choice of male or female type).

The *segmented area map,* an "exploded" view of which is shown in Fig. 2, covers the area in which the shop normally performs service calls. It is divided into four operating areas (A, B, C & D), with the shop in the center. Each home - call technician is assigned one or more of the operating areas (depending on how many technicians you employ and into how many operating areas you feel you need to divide your service area).

Calls received from within an operating area normally are given to the technician assigned to that area. However, if during a particular period, the number of calls received from an area is more than can be handled on a timely basis by the technician assigned to that area, the dispatcher can give the excess calls to the technician assigned to one of the two *adjacent* operating areas. For example, if the number of calls received from area A cannot be handled on a timely basis by the area A technician, the dispatcher can "divert" to areas B and C the area A excess calls which are closest to the boundary lines between A and B, and A and C. Normally, the dispatcher should not divert excess calls in area A to the area D technician because it would force the area D technician to travel an excessive distance. The dispatcher could, however, if the area D workload permitted, assign the area D technician to area A for a day, to help the area A technician catch up.

Also included on the area map are mileage circles radiating out from the shop site. These circles, which are one mile apart, are included to help the dispatcher estimate mileages during routing procedures. The darker circle defines that portion of the service area in which the shop's home - call flat - rate charge applies. Service calls to any point *beyond* this circle are charged the home - call flat - rate charge *plus* an "excess mileage" charge.

The *scheduling board,* in Fig. 1, is divided into four vertical columns (A, B, C and D) which correspond to the four operating areas on the segmented map. In each column are six pockets (or some other method of holding the service - call forms), one for each workday between Monday and Saturday.

As requests for in - home service are received, a two - copy service - call form (Fig. 3) is filled out for each. One copy is placed in the pocket which corresponds to the operating area (either A, B, C or D) in which the customer is located and the day of the week on which the customer was promised service.

Hung loosely on the lip of each workday pocket is a "U" - shaped, removable, medal or plastic "quota" tag, one side of which is red (or any color you desire) and the other side of which is white. The purpose of this tag is to provide a visual indication of whether or not the maximum number of calls that can be performed on that day by the technician in that area have been scheduled. The *white* side of a tag indicates that *more* calls *can* be scheduled in that area on that day. The *red* side indicates that the maximum number already has been scheduled, and all

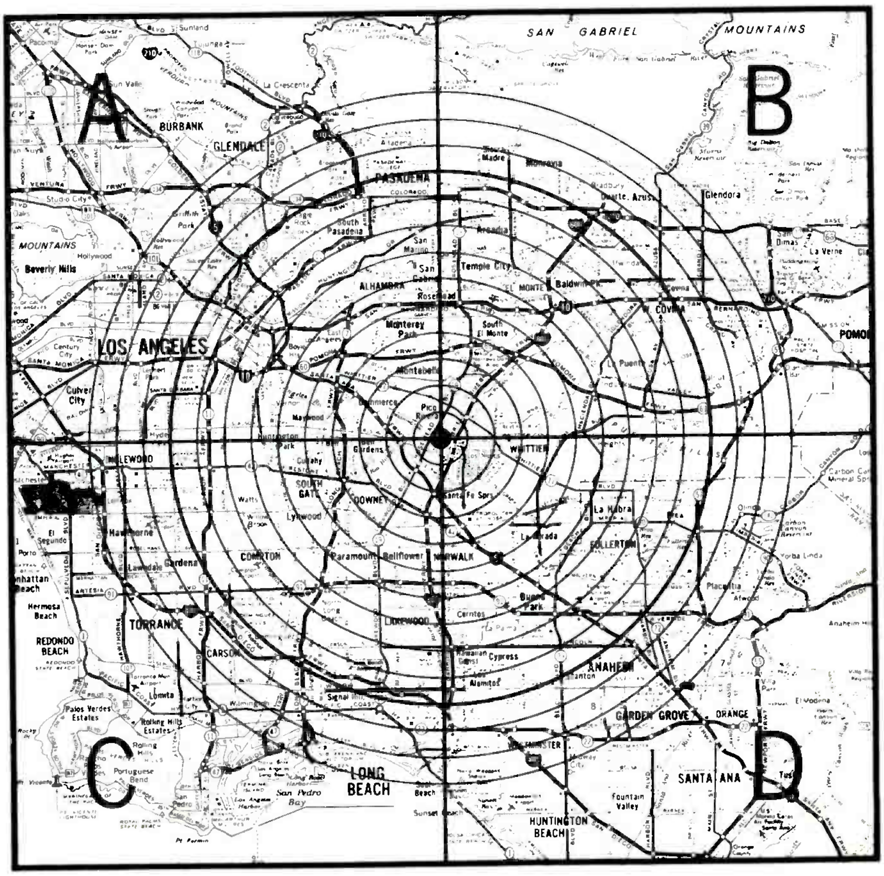

Fig. 2— Exploded view of segmented area map used with dispatching center illustrated in Fig. 1.

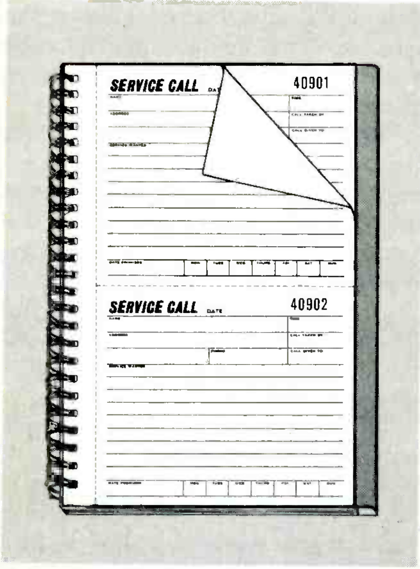

Fig. 3—Example of a service-call form that can be used with the home-call dispatching system described in the text. The form shown here is a carbonless, two - copy type with two separate, numerically coded forms per sheet. Each form is perforated so that the top, or original, copy can be removed from the book and inserted in the appropriate workday pocket on the scheduling board.

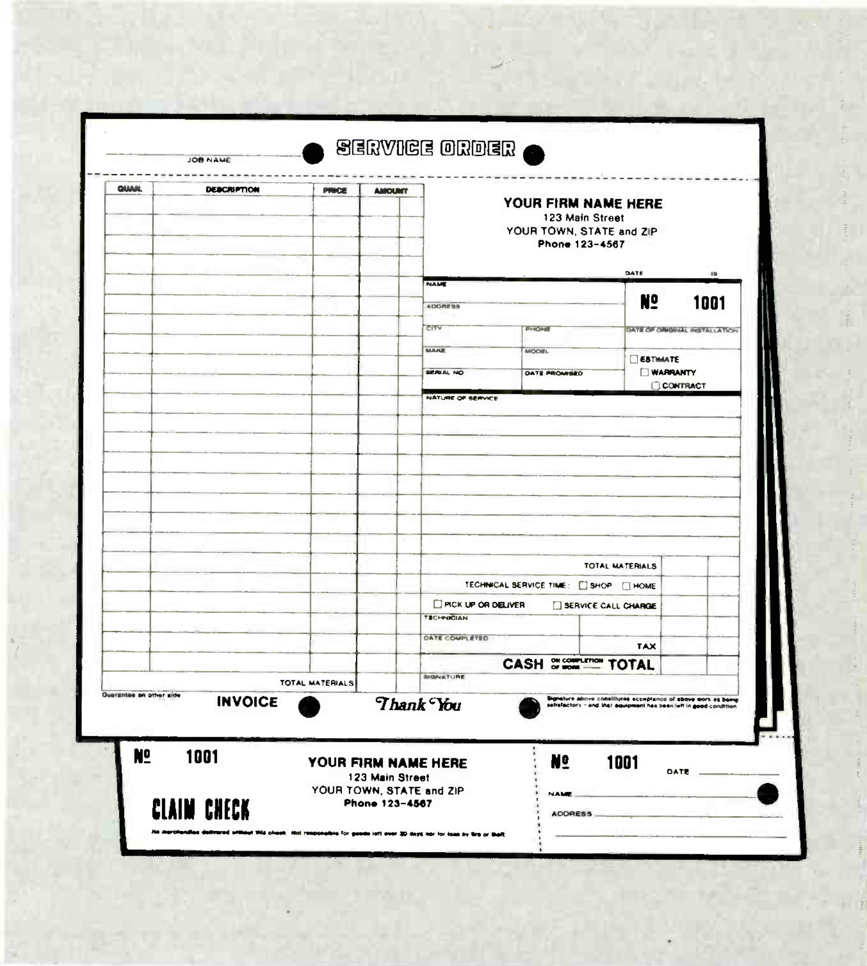

Fig. 4—Example of service - order form designed to meet the needs of electronic service businesses. *Courtesy of New England Business Service, Inc.*

subsequent requests in that area will have to be scheduled on the next "unfilled" (white tag) day in that area column.

At the bottom of each of the four area - related columns on the scheduling board is a pocket labeled "Unscheduled." If and when the maximum number of service calls have been scheduled for *each* of the six workdays in an operating area, as indicated by a red tag on each workday pocket in that area column, subsequent requests for service in that area either are left unscheduled or are assigned to the technician in an adjacent operating area. (Whenever a request must be accepted on an "unscheduled" basis, the customer should be told that no specific day can be given for the call, but that it will be made within the next six working days, and as soon as it is scheduled for a specific day, he or she will be notified in advance by phone.)

HOW THE SYSTEM FUNCTIONS

Logging and Scheduling Service Calls

When the call - taker/dispatcher receives a phone request for service, he (or she) obtains and enters on the service - call form the customer's name, address and phone number and the type of service requested. After determining in which of the shop's four operating areas the customer is located, the call - taker/dispatcher visually scans that area - related column on the scheduling board to determine on which workday the technician assigned to that area will be able to make the call. The red or white quota tags on each workday pocket quickly reveal to the dispatcher the earliest day that the call can be scheduled.

Assume, for example, that: 1) it is Monday, 2) the customer is located in operating area C, and 3) the status of the scheduling board is as shown in Fig. 1. The red (dark in Fig.1) quota tags on the pockets for Monday and Tuesday in the area C column tell the call - taker/dispatcher that the call *cannot* be scheduled on either of these days because they are already fully booked. The earliest the call can be made is Wednesday, which, as the white tag indicates, is not yet fully scheduled. The customer is told this, and, if that day is convenient for the customer, the call - taker/dispatcher checks the "Wednesday" square in the "Date Promised" section at the bottom of the service - call form (Fig 3.) and enters the letter "C" in the "Call Given To" square in the upper- righthand portion of the form.

The top, or original, copy of the service - call form then is torn from the service - call book and placed in the "Wednesday" pocket of the area "C" column on the scheduling board. The second copy of the form is left in the book as a permanent or back - up record of the call.

Routing of Calls For Following Day

Near the end of each workday, the call-taker/dispatcher removes from the scheduling board the ser-

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vice - call forms for the calls scheduled for the next day in each operating area and prepares a service - order form (Fig. 4) for each. The service - call form then is stapled to the top edge of the service - order form. (During the course of the following day, as the technician completes a call, he writes the word "completed" across the top of the service - call form. If the customer is not home or if for any other reason the technician cannot make the call, he writes the words "not home" or "not completed" across the top of the service - call form. This procedure will later alert the dispatcher that the call must be rescheduled).

After a service - order form is prepared for each call and the service - call forms are stapled to their respective service - order forms, the dispatcher is ready to *route* the calls in each area. To facilitate the routing, and to preserve the area map, it should be placed under glass (or a heavy, transparent sheet of acetate or plexiglass). The dispatcher then can mark on the glass with a grease pencil the approximate locations of the calls scheduled in each area for the following day. This will provide the dispatcher a clearer picture of the sequence in which the calls in each area should be made. The dispatcher then selects a sequence which minimizes the distance between calls and avoids needless backtracking. The sequence of calls in each area is indicated to the technician by placing a corresponding number in the upper righthand corner of the service - order form and by arranging the forms in the sequence in which the calls should be made.

Once the routing process is completed, the grease pencil markings can be wiped off the glass.

If the calls for the following day were originally received or scheduled more than two or three days ago, and if time permits, the dispatcher should phone each customer and remind them that a technician will be calling on them the next day. This will help reduce the number of "not - at - homes". Also, because by this time the dispatcher will have determined the sequence in which the calls in each area will be made, he should be able to tell each customer whether their call will be made in the morning, around noon or in the afternoon.

As an alternative to having the dispatcher phone each customer the day before the service call is to be made, or as a follow up to the dispatcher's call, each technician, upon completing a service call and before leaving the customer's home, could ask to use their phone to alert his next customer that his is on his way. If the next customer in the call sequence does not answer the phone, the technician should bypass that customer and phone the next in the sequence. (However, if the home of the customer who did not answer the phone is located within a block or two of the route, the technician will take from his present location to the next "at home" customer, the technician could stop by to verify that the customer really is not home. If the customer is not home, the technician should leave a note stating that he was there but since the customer was not home the call will be rescheduled for another day and the customer will be notified in advance. A preprinted hangtag is handy for such a purpose.)

When for any reason a technician cannot make a scheduled service call or if at any time during the day he realizes that he will have time to complete more calls than were scheduled for him, he should phone the dispatcher and request as many additional calls in his area as he believes he has time to complete that day. The dispatcher than should ask for the technician's present location, and select, from among the calls scheduled for that area the following day, those calls which can be efficiently routed into the remainder of the technician's workday. After receiving from the dispatcher the names, addresses and phone numbers of the "additional" customers, and after entering this data on the spare service - call and service - order forms he carries in his truck, the technician should phone each of the "additional" customers to verify that they will be home when he arrives.

Rescheduling Of "Not At Homes"

When each technician reports back to the shop at the end of the workday, he should turn over to the dispatcher all of the service - call forms he received that morning (plus any he prepared for additional calls he received from the dispatcher via phone during the day.)

The service - call forms for *completed* calls then can be filed away in the shop's *customer file*.

The service - call forms for calls that were *not* completed because the customers were *not home* should be placed in the "Not At Home" pocket on the scheduling board (Fig. 1), and, at his earliest convenience, the dispatcher should reschedule these calls on the earliest "open" day in that operating area and then inform each customer by phone of the rescheduled date. (Preferably, each "not at home" should be phoned no later than *one* day following the day on which the call was originally scheduled.)

Scheduling The Delivery Of In-Shop-Repaired Items

When a home - call technician brings in a receiver or chassis for in - shop repairs, the original service - call form should be left stapled to the top edge of the service order form and *both* forms should remain with the receiver or chassis during in - shop repair.

As soon as the in - shop repair is completed, the bench technician who completed the repair should remove the *service - call* form from the service - order form, write "shop repair completed" across the top and give it to the dispatcher so that he can use it to schedule the delivery of the repaired item.

Delivery of in - shop - repaired items should be scheduled as soon after the repair is completed as is possible. Ideally, the same home - call technician who brought in the item also should deliver it. However, if all of the workday pockets in that technician's area column on the scheduling board are fully scheduled (as indicated by red quota tags on each pocket in the column), the dispatcher should assign the delivery to a technician in an adjacent area.

As soon as the delivery of the repaired item has been scheduled, the dispatcher should phone the customer to verify that the scheduled delivery date is convenient. If it is, the dispatcher then should place the service - call form in the appropriate workday pocket and handle it as he would any other service call, except that he will *not* have to fill out another service - order form for it. (The original service - order form should still be with the repaired item.)

SUMMARY

The home - call dispatching system and related procedures described in the preceding paragraphs are designed to reduce the average distance your technicians must travel between calls but yet insure that all service calls and deliveries are made on a timely basis.

The system can be modified to meet the unique characteristics of any size of service business or geographical service area. For example, the geographical area served by a shop can be divided into more (or less) operating areas to accommodate either a larger (or smaller) service area or more (or less) home - call technicians. If you have fewer technicians covering a relatively large service area, you can divide the service area into small operating areas and then divide these among your home call technicians so that each technician is assigned two operating areas, which he serves on alternate days.

If you do modify the system to accommodate the unique characteristics of your business or service area, keep in mind that the principal purpose of the system is to *minimize* the average *distance* your technicians travel between service calls, and that the reason for doing so is to *increase* the average *number* of service calls your technicians make in a workday. Any modifications that do not contribute to these two interdependent objectives will probably reduce or eliminate the advantages you should gain from the system. ■

Auto Entertainment Electronics—A State-Of-The-Art Report—Part 1

By Joseph J. Carr, ET/D Contributing Editor

A look at the most recent circuit developments in car radio and tape products

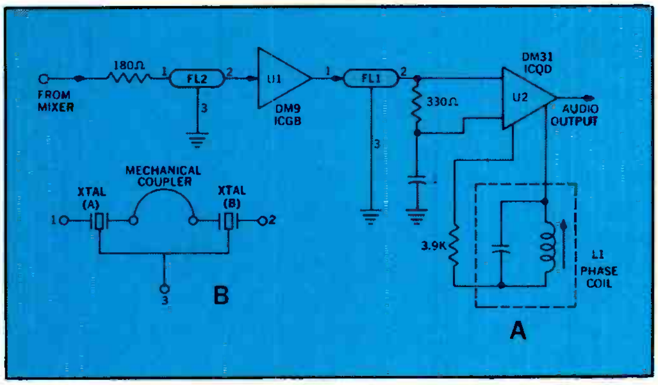

Fig. 1—A) Partial circuit of the Delco FM IF strip used in late - model AM/FM receivers. Insertion loss caused by use of ceramic IF filters is overcome by an IC gain stage (DM-9). The detector is one of the IC quadrature types. B) Functional drawing of ceramic filter.

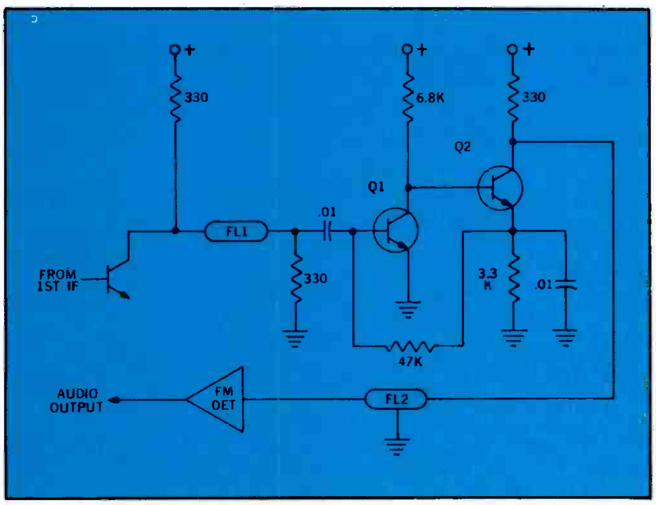

FIG. 2—In Motorola receivers for "high - end" cars, a two - transistor, wide band amplifier is used to overcome the filter loss. A quadrature detector is also used in this design.

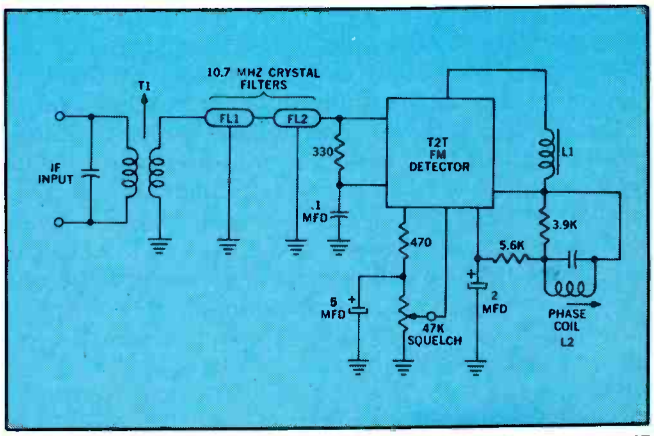

Fig. 3—In lower - cost receiver designs, the gain stage between ceramic IF filters is deleted and a "squelch" (muting) control is used in its place.

■ In the not too distant past, car radio servicing was relatively easy because even FM receivers were unsophisticated. Today, though the situation is different. Modern FM stereo car radios are at least as high on the technology scale as any home hi - fi equipment, with the possible exception of the lower - power audio stages used in car radios. It is probably safe to say that the 1971 - 1975 era for car radio design is at least as revolutionary as the 1957 - 1963 changeover from tube to transistor designs. In those days, we were saying, "Gee really, all transistors, eh!" Today, "all - transistor" can mean out - of - date circuitry! Almost everything is coming up ICs.

FM CIRCUITS

The amount and complexity of FM circuitry has decreased; yet, performance is up. This is attributable to the twin technologies of IC manufacturing and low - cost piezoelectric ceramic filters. These latter components have all but replaced the venerable IF transformer of yesteryear. Figs. 1 through 3 show how these two technologies have been used in actual circuits by two representative manufacturers of OEM (for car makers) radios.

Fig. 1 is a block diagram of the Delco system. The complex signal generated in the mixer is applied to the input of filter FL1, which selects out the desired 10.7 - MHz IF signal. The output of FL1 feeds an IC gain "stage" contained in a single Delco DM9 (a smallish affair in an 8 - pin, minidip package). Coupling between ICs U1 and U2 is via a second filter, FL2. The purpose of the DM9 gain stage is to overcome the insertion loss caused by the filters. IC U2 is an integrated - circuit version of the old quadrature detector scheme. Delco calls theirs the ICQD. This detector has become very popular in recent years, and all car radio manufacturers except Philco now use it. More is said about this chip later in this article.

Fig. 1B is a stylized view of the inside of the Murata ceramic IF filter used by Delco and Bendix (as well as a lot of home equipment makers). The transmission path consists of a pair of piezoelectric elements made of ceramic and coupled by a mechanical "horseshoe." Crystal A converts IF signals to mechanical vibrations which, in turn, are passed to crystal B via the "horseshoe." The mechanical vibrations are converted back to electrical signals by the action of crystal B.

The frequencies of these crystal filters are indicated by a code. When replacing one, it is necessary to use two of the same code. Most manufacturers recommend replacing both because the service parts are all of one group.

Figs. 2 and 3 show two crystal - filter - equipped circuits used in Motorola car radios. In Fig. 2, the first IF has a conventional transformer input to the base and a crystal - filter output. Signal from FL1 is RC - coupled to a wide - band amplifier consisting of Q1 and Q2. From there it is fed through a second crystal filter, FL2, to the input of a quadrature detector IC. Shown in Fig. 3 is a modified version which is used in lower - priced models.

For all practical purposes, the conventional diode - type FM detector is out and the ICQD is now the "reigning king". Fig. 4 shows the block diagram of the typical ICQD. IF input signal is fed to a multi - stage, wide - band, high - gain, limiting amplifier. The output from this chain is diverted in two directions. One component is sent directly to the input of a gated, synchronous detector. The other is first fed to a phase - shift tank circuit outside the IC. Here the phase is shifted 90 degrees before the signal is sent to the other input of the detector. The output of the detector is a chain of rectangular pulses whose widths (periods) are proportional to the instantaneous value of the FM input signal. These pulses are then integrated to extract the audio information. In some ICQD type chips the AFC is derived from the audio line, while in others it is picked off at a separate terminal.

Many FM car radio manufacturers still use bipolar transistors in the front end of some of their radios, but a few have switched to junction field - effect transistors (JFETs). Fig. 5 shows the front - end circuit used in some later models of Delco FM recivers. In this circuit, a DS - 88 JFET is used in a conventional common - source RF amplifier circuit. The relatively complex input network is used to provide impedance matching between the windshield antenna and the input RF tank. Shielded input and output signal lines and a ferrite bead on the Z+ line minimize problems caused by signal radiation.

REGULATED POWER SUPPLIES

It has long been recognized that FM radios, especially car radios, need a regulated source of DC power in order to keep the stations from drifting merrily about the dial. Until now, this regulation has usually been supplied by a simple zener diode regulator. However, certain 1974 - 75 Delco models are equipped with a DS - 512 transistor regulator (See Fig. 6). In this series regulator circuit, the base of the transistor is held constant by the zener diode. The voltage across the load (fed from the emitter of the transistor) is held to a constant value approximately equal to V_z + V_{be}, or about 0.7V DC higher than the voltage across the zener. These circuits improve the regulation (and hence both the stability and the "A - lead - borne" noise) by a factor proportional to the beta of the series regulator transistor.

PLL STEREO DECODERS

Some years ago, Motorola Semiconductor Products, Inc., (not to be confused with the car radio division of Motorola) collaborated with a nationally known maker of hi - fi equipment to produce the first IC stereo decoder. These original chips are now known as the Motorola MC1304P, MC1305P and MC1307P. Delco then offered the DM - 14 IC stereo decoder.

The original chips are no longer used extensively in new equipment. Their bulky resonant tank circuits (up to three) are less appealing now that we have phase - locked - loop (PLL) decoders, which use either a single inductive tank circuit or none at all.

In 1972, Bendix introduced the first car - radio application of PLL. Delco is now in the a PLL market with their DM - 54, as is the car - radio division of Motorola Semiconductor Products offers a "coil - less" PLL under the type number MC131OP.

Rather than bog ourselves down describing all PLLs used in car radios, we'll examine one representative coil - less type: the Delco DM - 54. A block diagram of this chip's circuits are shown in Fig. 7. The input signal is amplified and separated by the composite stage. The 19 - KHz pilot signal, in turn, is broken into two components. One is fed to a threshold (amplitude) detector. This circuit drives one input of a

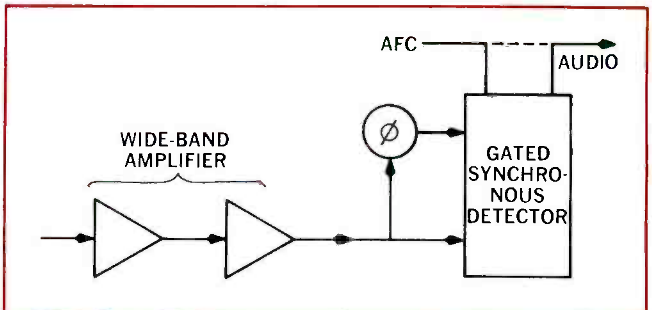

Fig. 4—Internal stages of a typical IC quadrature detector.

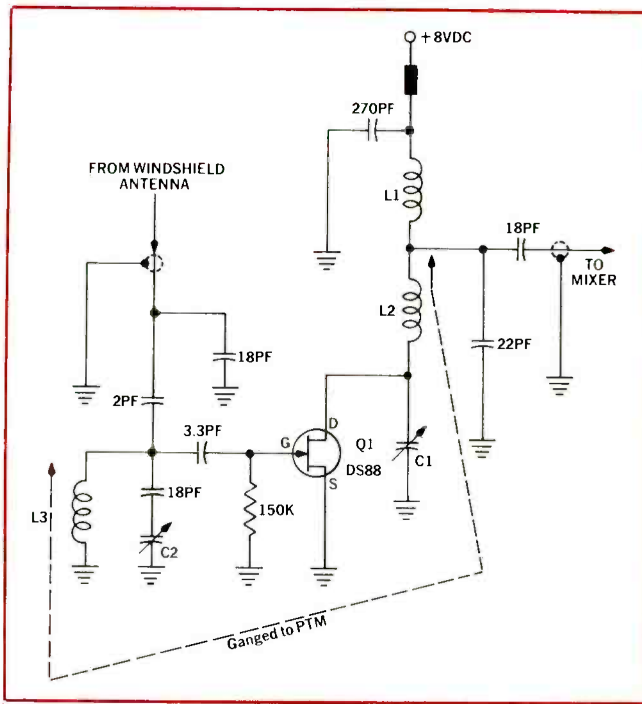

Fig. 5—JFET FM RF amplifier which uses the Delco DS - 88 transistor. Impedance matching to the windshield antenna requires a relatively elaborate input network.

two - input *AND* gate which functions as a mono-stereo switch. The AND automatically turns off the decoder when reception is too marginal for good stereo; a feature which allows continued use of the radio in the mono mode.

The other component of the pilot is sent to the PLL section. The heart of any PLL is a voltage - controlled oscillator (VCO). The frequency of the VCO changes when the DC input control voltage changes. In stereo decoder chips, a 76 - KHz VCO, equipped with either an LC tank or RC network, is used to course - adjust the frequency. A series of flip - flop circuits then convert the square wave output of the VCO to 38 - and 19 KHz signals. The DC control voltage needed by the VCO is developed by comparing the phase of the incoming pilot signal with that of the 19 - KHz signal from the output of the flip - flop divider chain. The DC voltage at the output of the phase detector is proportional to the difference of the frequencies of these two signals. The control voltage is amplified and fed to the control - voltage input of the VCO. If the 76 - KHz VCO begins to drift off frequency, the DC control signal increases or decreases to bring it back on frequency. This system is similar but not identical to convential AFC systems.

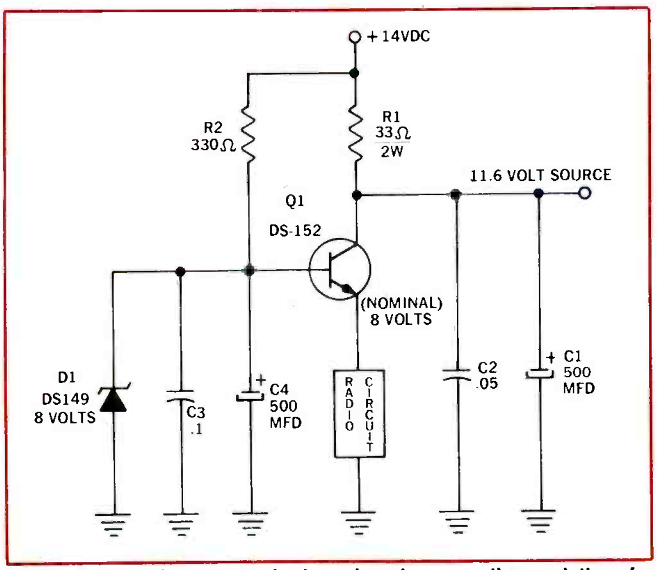

Fig. 6—Regulated power supply shown here increases the regulation of a simple zener diode by a factor proportional to the beta of the DS - 512.

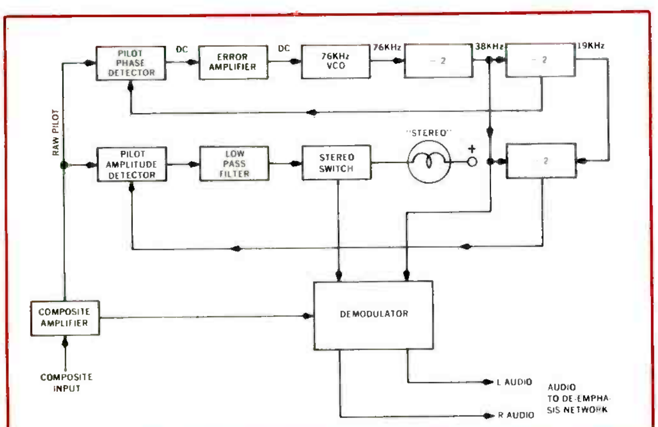

Fig. 7—Block diagram of the internal circuitry of a phase - locked - loop (PLL) stereo decoder IC. The PLL portion is used to regenerate the stereo suppressed subcarrier.

In addition to the application just described, PLL circuits are used as FM demodulators, as frequency control circuits in some TV and FM tuners, and as the frequency control for modern, high - cost signal generators called wide - range synthesizers.

All car radio manufacturers who use the PLL recommend that it be aligned by adjusting the frequency control (either a pot or, on Bendix models, a coil) until a stationary Lissajous pattern is produced on the oscilloscope screen. I have seldom found this procedure necessary. Because the PLL will "capture" a VCO that is slightly misadjusted, you need only get the VCO adjustment close and the PLL action will do the rest. To check PLL locking action, tune across the FM band and select the weakest station that produces proper action of the stereo indicator lamp. Tune to the station from both above *and* below it, to make sure it "captures" normally.

If the preceding technique is not possible in your area, grab the scope and a stereo signal generator, and use the technique recommended by manufacturers.

PHILCO-FORD'S VARACTOR-TUNED RECEIVER

In 1972 Philco - Ford introduced a relatively unique car radio design that is still being used. Fig. 8 shows a sectional block diagram of this receiver. In the FM mode, the front end (RF amplifier and local oscillator) is voltage - tuned by a few variable - capacitance (varactor) diodes. The front - end stages, the IF strip and the FM demodulator are on a single printed - circuit board which is mounted along the real panel of the radio. The demodulator is a diode type, although you can easily mistake it for a quadrature detector (QD) because the diodes are "hidden" within an RCA CA3043 ICA. However, the fact that it is a diode type is still visually evident because the QD uses a phase coil, as opposed to the transformer used in the Philco.

The stereo decoders and complete audio section are located on a second printed - circuit board. The AM circuits and the special section used to generate the FM control voltage (for tuning the varactor front end) is contained on a third printed - circuit card.

A partial schematic of the control voltage stage is shown in Fig. 9. Transistor Q1 functions as a VLF Colpitts oscillator tuned by C1, C2, L1 and L2. (The frequency of this oscillator is several hundred kilohertz, but the actual frequency is unimportant.) This circuit develops an AC output voltage, E1. Diode D1 rectifies this signal and applies the resultant DC to a three - transistor control amplifier, designated as A1 in Fig. 9. Amplifier A1 generates the negative feedback signal which controls the amplitude of the output of Q1. In this way, E1 is held constant.

The acutal tuning voltage is generated by rectifying E1, the AC signal across coil L2. Because L2 is fixed and L1 is tunable (and ganged to the permeability tuning mechanism), the level of E2 will change along with changes in the inductance of L2. The output voltage is filtered in an RC network which is contained within a ceramic package similar to the type used by Philco since their re - entry into the car radio market back in 1965. The level of tuning voltage ranges between 0.7 and 6.8v DC, depending upon the setting of the tuning dial.

IC TROUBLESHOOTING

The advent of IC technology, according to many "knowledgeable" people, was suppose to eliminate the need for servicing and, therefore, the servicer. This has not happened, principally for two reasons:

1) The present cost of ICs and the state of the art of other component and manufacturing technologies involved in the production of consumer electronics have, to date, precluded the possibility of throw - away boards and/or modules.

2) ICs, like discrete simiconductors, *are* seemingly more reliable than tube - equipped circuits; however, present - day manufacturing techniques have not produced semiconductors which are sufficiently "pure" and of sufficiently "tight" parameters to completely eliminate defects and failures.

On the other hand, ICs *have* made the *diagnostic* aspect of servicing easier. Instead of having to isolate the cause of a trouble symptom to a single discrete component among many possibly defective ones, we merely have to *sectionalize* the problem to a single IC, in which is contained a large percentage of the previously discrete components. (This, in effect, eliminates the *isolation* aspect of diagnosis.) In auto radio servicing, sectionalizing the problem to a single IC usually can be accomplished by measuring the DC voltage on the pins of the IC and comparing them to the "normal" voltages listed in the service data. A chart which accompanies this article lists the "normal" voltages on the pins of ICs which are representative of the types encountered in car radio and tape products.

IN PART 2

Low - cost substitutes which can be used to replace many FM and stereo ICs, and the new and most significantly changed circuits and features of car tape products will be discussed in the second, and final, installment of this state - of - the - art report. ■

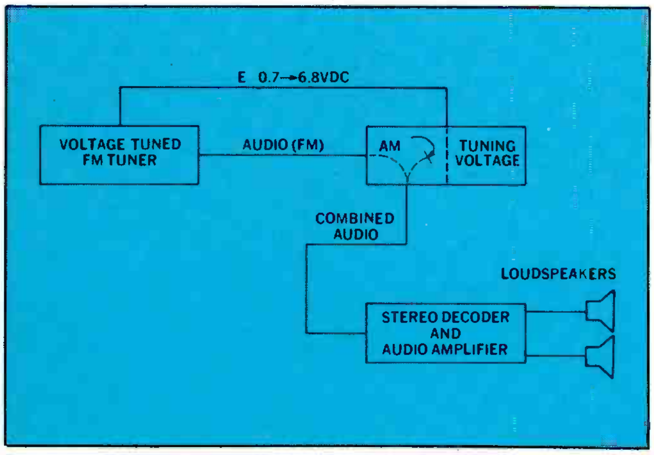

Fig. 8—Block diagram of the Philco - Ford receiver used in Fords.

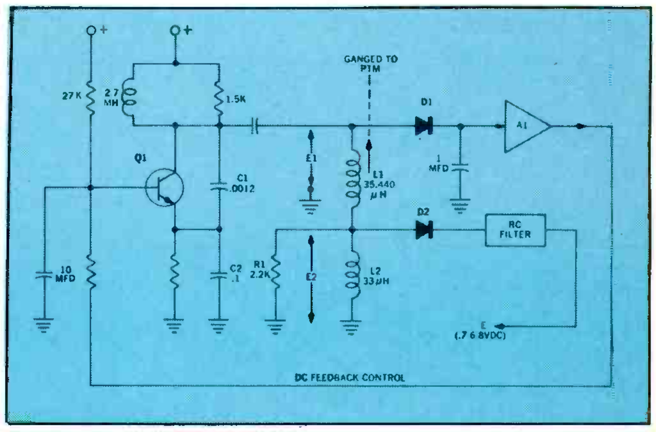

Fig. 9—Circuit used to generate the DC tuning control voltage in Philco - Ford varactor - tuned FM receivers.

COMMON AUTO RADIO IC PIN VOLTAGES

PIN NO.	DM-11 DM-31 (ICQD)	DM-14 (NON PLL STEREO DECODER)	DM-9 (ICGB)	DM-41 (ICQD)	DM-35 (ICAM)	DM-29 (AUDIO IC)	DM-48 (AUDIO IC)	DM-44 PLL STEREO MODULE "A"	DECODER MODULE "B"	DM-30 (TAPE PREAMP)
1	3.9	8.0	1.4	3.5	7.2	.50	.60	3.4	2.4	13.2
2	3.5	2.1	1.4	3.6	4.0	1.3	1.3	5.7	3.4	7.0
3	—	3.0	2.8	14	.60	1.5	1.5	5.4	3.3	1.4
4	1.4	1.9	0	1.3	.60	0	0	4.7	2.5	2.7
5	1.4	1.9	2.3	1.3	.60	0	0	4.6	2.5	3.5
6	1.4	13.2 (.7)*	—	1.3	0	12.6	12.7	5.3	3.2	0
7	0	0	—	0	0	13.2	13.5	13.2 (1.0)*	13.2 (1.0)*	1.4
8	0	5.0	14	0	.60	—	12	GRD	GRD	1.4
9	.15	8.0	—	.20	14	—	—	2.9	1.8	0
10	1.5	3.7	—	—	.20	—	—	2.9 (3.1)**	1.7 (2.3)**	3.5
11	—	6.0	—	—	4.9	—	—	2.0 (0.1)**	1.3 (2.4)**	2.7
12	3.5	6.0	—	3.3	7.2	—	—	2.9	1.8	1.4
13	8.0	3.7	—	8.0	7.2	—	—	2.9	1.8	0
14	4.5	0 (1.9)%	—	4.0	4.9	—	—	2.9	1.8	0
15	—	—	—	—	—	—	—	3.0 (4.2)**	3.0 (4.5)**	—
16	—	—	—	—	—	—	—	13.2	13.2	—

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New In Color TV For 1975 — Part 7

By Joseph Zauhar

Continuation of a series which analyzes the new and significantly changed circuits in 1975 color TV receivers. This month we will review the new circuits used in Zenith's Titan chassis and the varactor tuning system

■ Zenith's 1975 line of color TV receivers features a 100 - percent solid - state Titan vertical chassis with the same basic construction in 17-, 19-, 23- and 25 - inch diagonal screen color TV sets.

In the "F" line, an increased number of color TV receivers feature the convenience of Varactor Tuning. In addition to the models that use the Varactor Tuner - Space Command Assembly are 17-, 19- and 25 - inch (diagonally measured) recievers that use the Varactor Tuning System without the remote control of Space Command.

COLOR TV CHASSIS 17/19EC45

The 19EC45 is the most powerful color TV chassis available from Zenith, producing 29.6 kv of second anode voltage for the Chromacolor II picture tube. It is an expansion of the company's modular solid - state circuitry and is used in either large or small - screen color TV sets.

The 17EC45 and the 19EC45 chassis are mounted vertically in the cabinet for easier access when servicing the TV set. The vertical portion of the chassis contains seven plug - in *Dura-Modules* which are fastened with plastic turnbuckles, as well as a plug - in IF module. Over 80 percent of all the chassis components are mounted on the modules as shown in Fig. 1. All of the *Dura-Modules* used in the chassis are special carrier panels that mount and interconnect solid - state devices in a desired configuration. The modules vary in size from single ones that are 3½ inches by 2⅜ inches to the largest that measures 4¾ inches by 3½ inches.

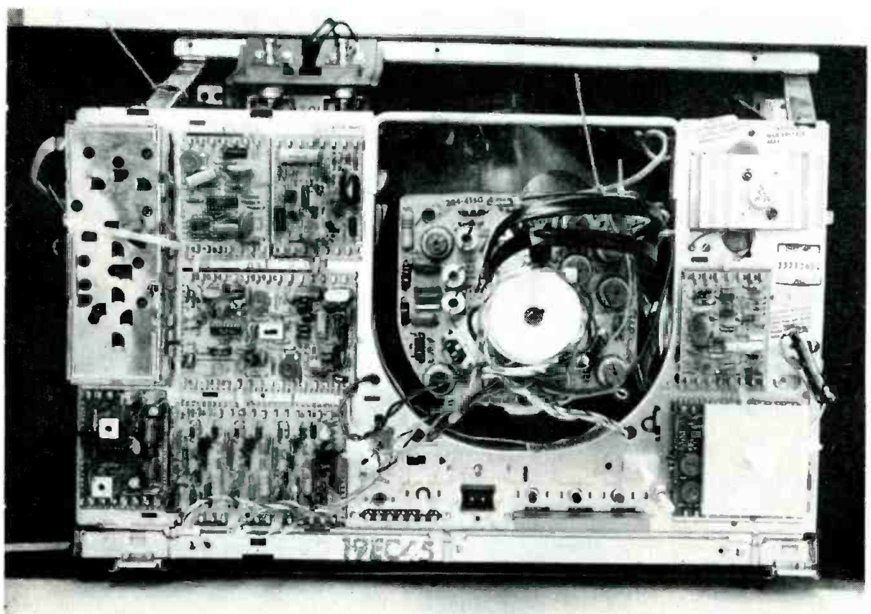

Fig. 1 — Zenith's 19EC45 color TV chassis with over 80 percent of all chassis components mounted on plug - in modules.

The chassis feature unitized construction which enables the chassis, the yoke and convergence assembly, the picture tube, degaussing shield and tuners, to be functional when removed from the cabinet. After removing six screws the entire unitized assembly can be removed from the cabinet. If desired, the chassis may be removed by disconnecting the cables at the plugs and removing four screws. The vertical portion of the chassis is hinged and drops to a 45 degree angle, and in this position the chassis will still operate.

Power-Sentry System

The *Power - Sentry* system employed in this chassis (Fig. 2) uses magnetic voltage regulation rather than electronic voltage regulation. This system is unique in 51 sets of Zenith's 1975 color TV line and replaces the conventional power transformer and complex electronic circuitry. The voltage regulating transformer (VRT) converts unregulated AC line voltages to a regulated AC voltage for use in the chassis, maintaining it at the specified operating level. It functions internally within the power transformer regulating and protecting all chassis circuitry. The low voltage power supply is mounted on the horizontal section of the chassis.

Deflection Yoke Assembly

A new integrated yoke assembly employs a molded plastic deflection yoke housing which mounts on the neck of the picture tube. An integrated printed convergence circuit board, with pole - piece sub - assembly modules, mounts on the rear of the plastic housing. On the 17EC45 and 19EC45 vertical chassis family, the pincushion correction circuitry board is also within the housing, but mounted onto the yoke clamp. For all horizontal chassis modules, the pincushion correction board will continue to be mounted on the chassis.

The yoke uses parallel connected horizontal coils. The same windings, when series connected, are used for all hybrid chassis. The vertical coils and connections are identical.

The deflection yoke unit Zenith Part No. 95 - 3103, is now a basic component of the new integrated assembly. It is a version of the same coil assembly found in the previous No. S - 93256 or No. S - 89750 yoke.

Vertical Blanking/Video Circuit

A new video blanking feature has been added to the 17/19EC45 vertical chassis. This circuit provides video blanking, should the vertical module, deflection yoke, or pincushion circuit fail.

The video blanking transistor, Q905 (Fig. 3) receives a sawtooth waveform from the yoke current sensing resistor R203, driving Q905 into saturation and rapidly charging capacitor C908 toward the B+ voltage. This capacitor provides a positive voltage to the base of vertical blanker transistor Q901, forward biasing the base - emitter junction during the trace interval. During the trace time, capacitor C908 discharges through resistor R907 and the vertical blanker transistor Q901.

The DC collector potential of the vertical blanker transistor Q901 will be quite low during the trace interval, resulting in a low potential on the base of blanking driver transistor Q903. The low potential on the base of Q903, results in a reverse emitter - base bias condition cutting it off.

Operation of the video circuitry is the same as in previous receivers. With the blanking driver transistor Q903 cut off, a low potential will be present at the emitter of the second video transistor Q904. The low potential on the emitter of the second video transistor Q904, produces a forward emitter - base bias condition and Q904 conducts.

This action causes the collector voltage of the second video transistor to decrease. The decrease in the DC voltage is coupled to the base of video driver transistor Q1204. The base - emitter junction of Q1204 is forward biased, causing it to conduct. The resulting drop in emitter voltage of Q1204 is DC coupled to the emitters of the color video output transistors Q1205, 6 and 7. The color video output transistors are forward biased and begin to conduct, placing approximately +140 volts on the picture tube cathodes. The picture tube is now forward biased, and causing beam current to flow.

During the vertical blanking interval, a negative going blanking pulse is applied to the base of the vertical blanking transistor Q901, driving it to cut off. This results in a high positive potential on the collector of Q901. The high positive potential is DC coupled to the base of blanking driver transistor Q903, driving it into saturation. This will cause a positive potential

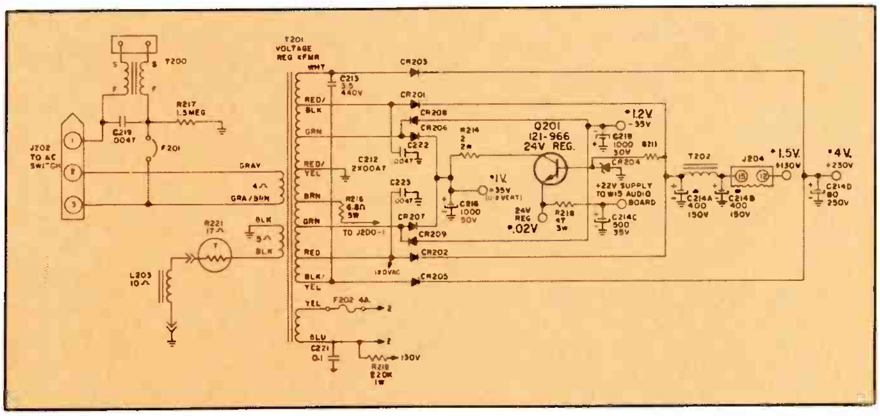

Fig. 2—Schematic diagram showing the Power - Sentry system employed in the 17/19EC45 color TV chassis, using a voltage regulator transformer (VRT). *Courtesy Of Zenith.*

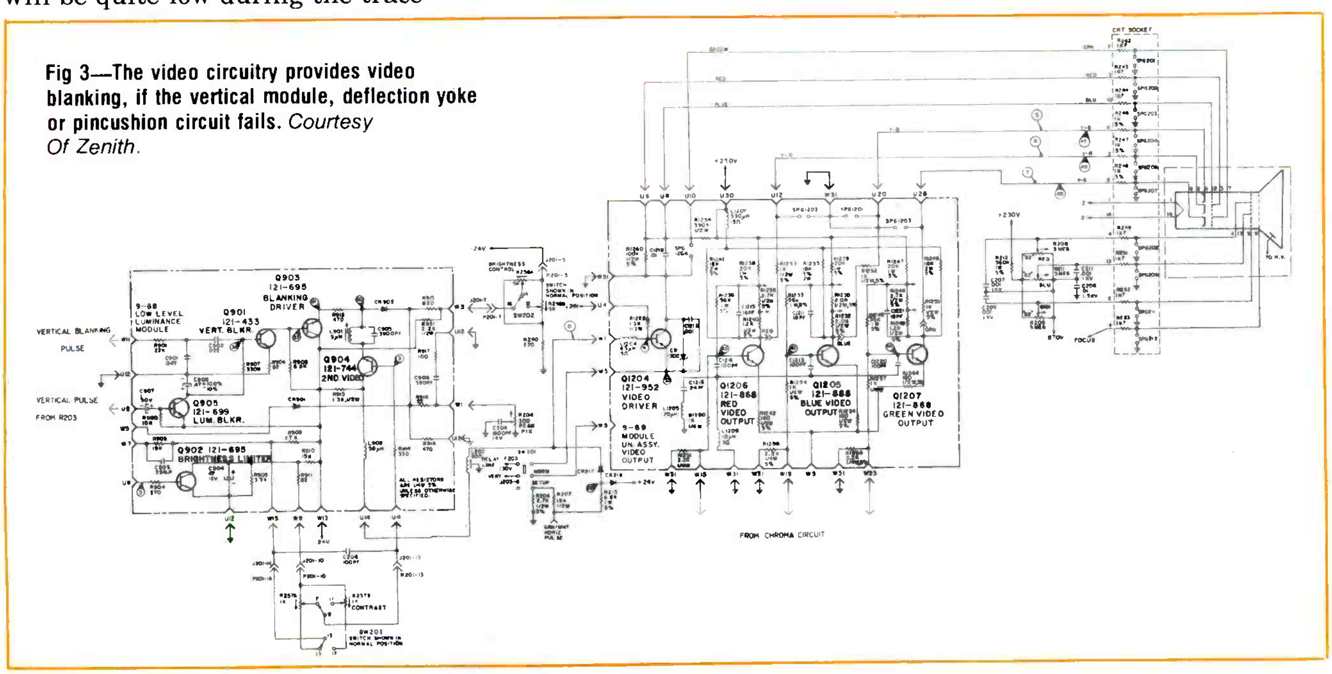

Fig 3—The video circuitry provides video blanking, if the vertical module, deflection yoke or pincushion circuit fails. *Courtesy Of Zenith.*

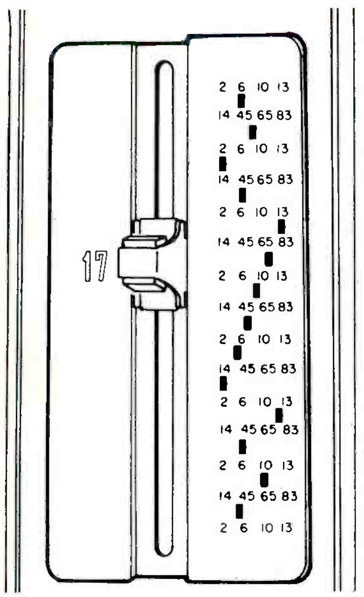

Fig. 4—The Varactor Tuner - Slider escutcheon used on TV sets without Space Command tuning. *Courtesy Of Zenith.*

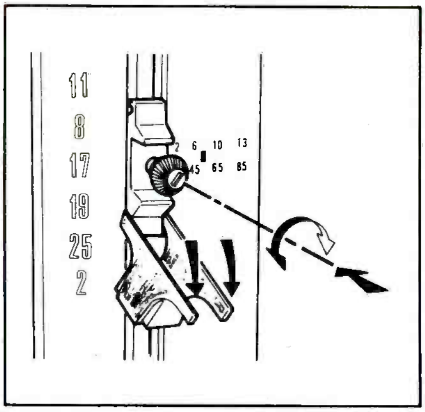

Fig. 5—The fine tuning knob is rotated to adjust the appropriate potentiometer, which in turn selects the proper tuning voltage and operates the tuner at the desired frequency. *Courtesy Of Zenith.*

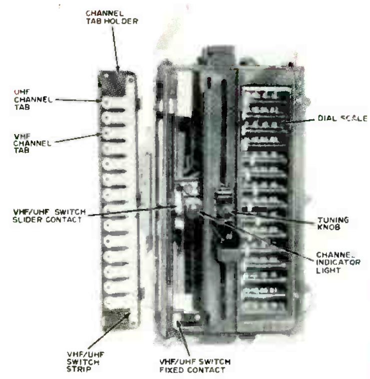

Fig. 6—The complete Varactor Tuner - Slider Assembly. *Courtesy Of Zenith.*

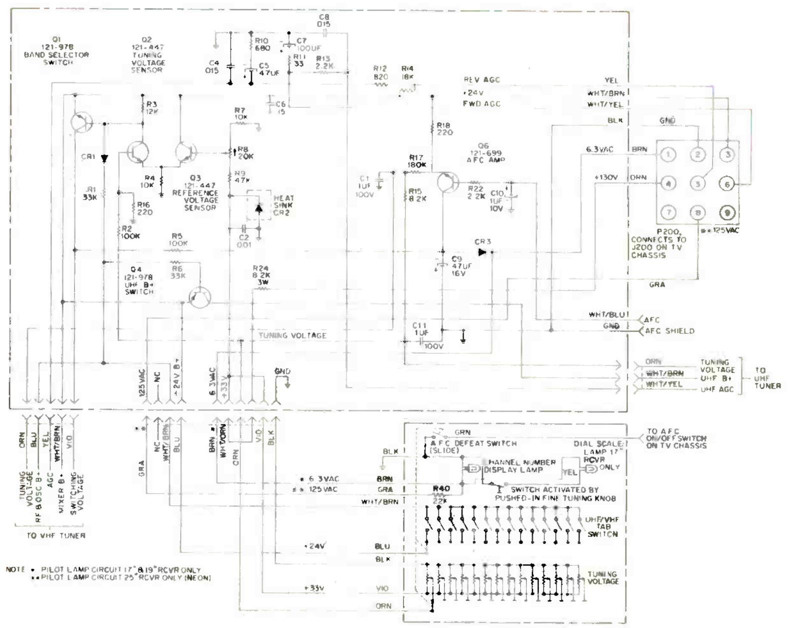

Fig. 7—Schematic diagram of the Varactor Tuner Control Center and Slider circuitry. *Courtesy Of Zenith.*

to be applied to the emitter circuit of the second video transistor Q904, driving it to cut off.

The rise in the collector voltage of Q904 is then DC coupled to the base of video driver transistor Q1204, driving it to cut off. This essentially opens the emitter circuit of the color video output transistors, driving them to cut off. When the color video output transistors are cut off, the cathode potential on the picture tube will rise toward B+, cutting it off and no beam current will flow. This circuit functions the same as in previous TV receivers.

If the vertical module, yoke or pincushion circuit fails, the yoke sensing resistor R203 will not provide a sawtooth waveform to the video blanking transistor to drive it into saturation. Thus, capacitor C908 will not charge toward B+. The positive voltage supplied to the base of vertical blanker Q901 will not be available and it will not conduct. The blanking driver transistor Q903 and video transistors will remain in the blanking mode of operation.

Varactor Tuner-Space Command System ("F" Line)

The Varactor Tuner - Space Command System as employed in the "F" line of color TV receivers is basically the same as the ones used in the "E" line models. Improvements made in the late production of "E" line assemblies will follow through on the "F" line. These changes include the following items:

1) A MUTE position on the Volume Stepping Function of the Four Function Space - Command unit. 2) Simplification of the cabling and connector networks. 3) Bracket modification on 17 - inch Varactor Tuner - Space Command mounting to simplify removal from the cabinet. 4) Metal Oxide Varistor (M.O.V.) protection for the photocell.

Some models of the "F" line will employ VHF tuners equipped with 7.5 - ohm antenna inputs.

Later production of the "F" line Varactor Tuner - Space Command systems will include a new Space Command chassis board which in-corporate the following changes: 1) A Triac with self - mounted heat sink, relocated on the board. 2) Individual Volume Step resistance adjustments. 3) The Varactor Tuner - Space Command assembly will be used in more models of receivers than in the "E" line.

Varactor Tuning, Without Space Command ("F")

There will be an increased number of color TV sets employing Varactor Tuning Systems without the remote control of Space Command in the "F" line.

The functions of switching the tuning voltage, the UHF/VHF mode of operation, and the channel light indication are performed by a sliding mechanism that is incorporated in the Varactor Tuner package. This unit is mounted to the cabinet, with the slider control accessible to the operator of the TV set.

The Varactor Tuner - Slider as it appears from the front of the cabinet is shown in Fig. 4, on the 17 - and 19 - inch model TV sets. The one used on 25 - inch models is similar, but it has a larger dial and channel indication. Fourteen separate positions are available for the selection of VHF or UHF channels. Any position can be adjusted for any one of the twelve VHF or seventy UHF channels. A sliding mechanism moves a detented channel selector knob to the desired position. Shown in Fig. 5 is the operation of the fine tuning knob to adjust the appropriate potentiometer, to select the proper tuning voltage, and operate the varactor tuner at the desired channel frequency.

An illuminated channel indicator is located to the left of the slider showing the channel number selected for each tuning position. A single pilot lamp behind this indicator moves with the slider assembly to each tuning position.

The 17 and 19 - inch models use a 6.3 volt AC incandescent bulb to illuminate the number of the channel selected, while the 25 - inch models employ a 120 volt AC neon bulb for this purpose.

The complete Varactor Tuner - Slider assembly as viewed from the front is shown in Fig. 6.

Tuner Control Center

Most of the Tuner Control Center is unchanged from the one used in the "D" and "E" line Varactor Tuner assemblies. One change was made in the AFC Amplifier circuit. Now only one transistor is used, instead of the two. The end connector that connects to and from the mechanical switching system has also been changed. These circuit changes are shown in the schematic diagram (Fig. 7) for the Tuner Control Center and the Slider - operated switches. The variations in the wiring for the 17-, 19-, and 25 - inch diagonal TV receivers also are shown. ■

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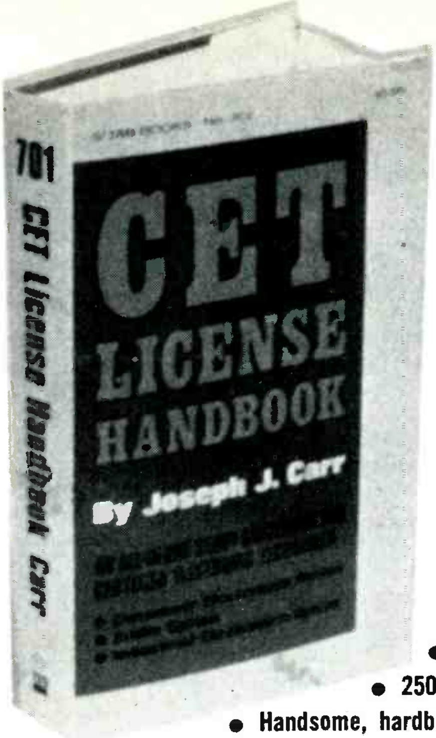

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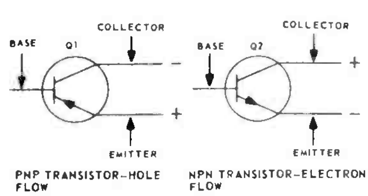

Fig. 9-7. Symbols for bipolar transistors.

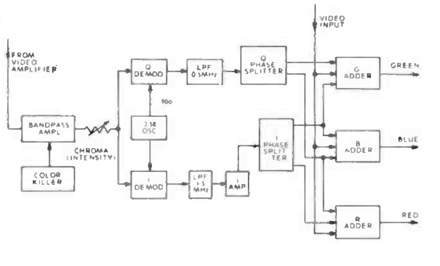

Fig. 12-7. An example of IQ demodulation.

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Semiconductor Diodes—A Perspective For Servicers

By Bernard B. Daien, ET/D Contributing Editor

Characteristics, applications, common failure modes, replacement, and test methods

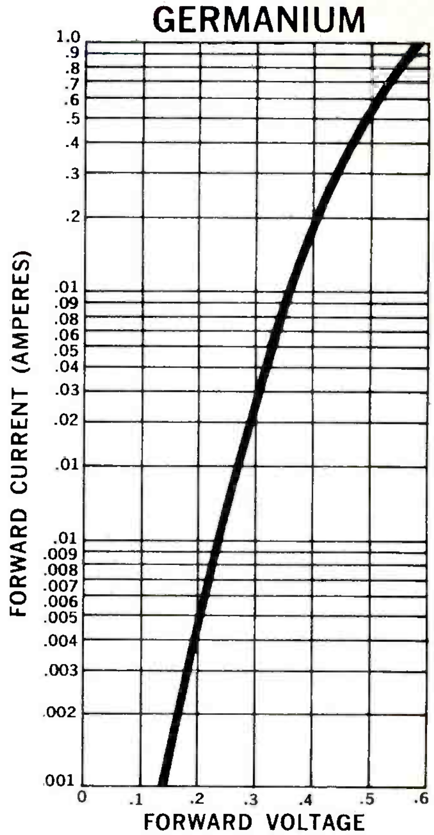


Fig. 1—Forward voltage - forward current curve for a germanium rectifier.

■ Although the transistor is regarded by most people as the device that marked the beginning of the semiconductor era, the diode really deserves that distinction. Old timers still recall the galena detector which used a cats whisker (the first point - contact solid - state detector). About the same time, in the early 1920's, the silicon detector made its debut in the form of a piece of silicon sandwiched between two pressure plates. (I have one made by the Union Carbide Corporation, dated 1924, and it still works as well as the day it was made.)

Despite these early developments in semiconductors, the thermionic tube caught the industry's fancy, and all development turned toward tubes for a quarter of a century. (Who knows how far along solid - state devices would be today if that little detour had never occurred.) However, even during the vacuum tube era many solid - state diodes were used: The copper oxide rectifier (forerunner of the Schottky diode) was used extensively as a meter rectifier in instruments because it required no filament, generated no potential to upset small - signal readings, and had a low voltage drop. And the 1N34 germanium point - contact was the first germanium device to achieve extensive use, replacing tube - type video detectors and high - frequency mixers in the early 1940's. The selenium rectifier was *the* rectifier in the 1940's in millions of radios and television sets. And don't forget the 1N21 silicon UHF radar diodes used during World War II in military equipment.

There is no need to elaborate further because the preceding examples are sufficient proof that solid - state diodes preceded the vacuum tube era, coexisted with it, and now appear to be destined to outlast it.

Today, copper oxide and selenium diodes are obsolete, and germanium is rapidly being phased out of most applications. Only silicon flourishes, and it survives in many variations, doing most of the jobs formerly performed by the other devices. Each variation has its own distinct characteristics which, in turn, require their own specific tests.

In general, modern diodes have vastly improved characteristics and stability compared to most of the earlier devices. Unfortunately, the "marginal" defects of earlier devices are still remembered and mistakenly attributed to modern devices even though most either become *completely* shorted or *completely* open circuited, with very few leakers, drifters or other "marginal" defects which plagued early solid - state diodes.

Despite the common impression that a diode is a device so simple that it deserves scant attention, the diversity and complexity of modern diodes is increasing. Television sets now use all - solid - state tuners equipped with tuning diodes (varactors), which replace variable capacitors and variable inductors; PIN switching diodes, which replace the channel selector switch; and light - emitting diodes (LEDs), which replace the channel indicator.

In communications and industrial applications, the four - layer diode (snap diode) has received acceptance. Schottky diodes are used for fast switching in high - speed computers and as power rectifiers in high - frequency power supplies or in other circuit applications in which a lower forward voltage drop is needed than can be obtained with more conventional silicon PN rectifiers.

Silicon photodiodes are used in photocouplers, in which the light from an LED "turns on" a photodiode, forming a switch which provides complete electrical and mechanical isolation between the input and output circuits. These "relays" have no moving parts, indefinite life, high - speed operation, and are small, lightweight and inexpensive. You will be seeing more of them as time goes on.

There are many more types of diode devices in use than mentioned above, but space precludes listing them all. In this article, we will discuss the types you are most likely to encounter in consumer electronics applications.

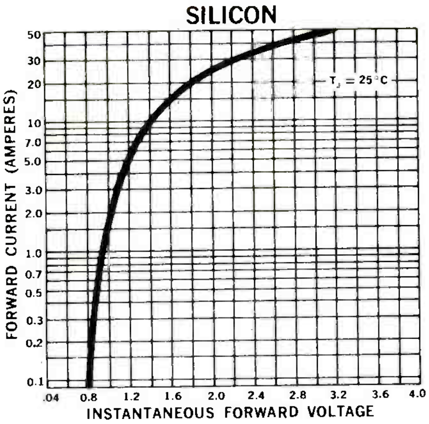


Fig. 2—Forward voltage - forward current curve for a silicon rectifier.

POWER RECTIFIERS

Occasionally, you might be called upon to repair older sets equipped with either germanium or selenium rectifiers. Germanium devices have a slightly lower voltage drop in the forward direction than do silicons. Fig. 1 shows the forward - voltage drop for a germanium rectifier at various currents, while Fig. 2 is the forward voltage - current curve for a silicon rectifier. Note that at one ampere germanium has about a 0.6 v forward drop, while silicon has almost a 1v drop. But how about reverse leakage and temperature effects? Silicon has significantly lower leakage than germanium, and can withstand higher temperature. Therefore, you can replace obsolete germanium power rectifiers with silicons. (This replacement criteria does not apply to signal or biasing diodes.)

Much the same applies to the replacement of selenium by silicon, with the one exception that selenium rectifiers have a relatively large forward - voltage drop of about 4 or 5 volts per cell. Thus, a 5 - cell selenium stack would drop about 20 volts in the forward direction. Because the silicon rectifier drops significantly less forward voltage, when replacing a selenium with a silicon it is advisable to place a resistor of suitable ohmage and wattage ratings in series with the silicon rectifier in order to supply the required DC voltage under load. (One word of

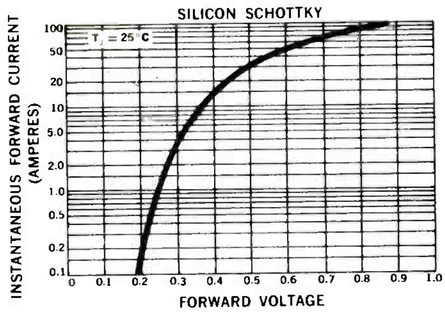


Fig. 3—Forward voltage - forward current curve for a silicon Schottky rectifier.

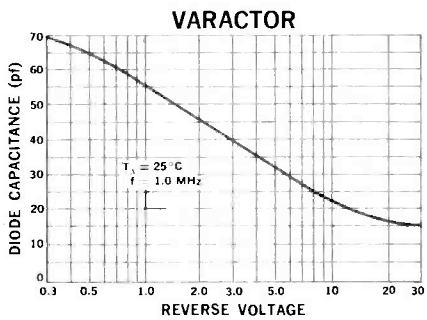


Fig. 4—Reverse voltage - capacitance curve for a varactor diode.

caution: The dropping resistor will be dissipating higher wattage than you might expect, because most sets use capacitor input filters which draw high peak currents. Check the resistor after the set has operated for a few minutes. If it is too hot to touch, even momentarily, replace it with a higher - wattage unit.) When the voltage multipliers or high - voltage selenium stacks used in some TV receivers are replaced by silicons, the DC voltage out of the rectifier will increase almost 100 volts, and, depending upon the rating of the filter capacitors, they might "pop", or even worse, they might draw heavy leakage current as a result of trying to form up to the new higher voltage. This, in turn, loads down the rectifier circuit so that the output voltage appears to be only 30 or so volts high. (If you let the set operate for ten minutes, you will notice the electrolytics running hot.)

At the present time, Schottky diodes, which are silicon diodes made by a different process, are available only in voltage ratings of less than 100v or so. They cost more, but are capable of being switched at a faster rate without loss of efficiency, and they also have a lower forward - voltage drop. Thus, you can expect to find them in some inverters which operate above a few thousand hertz, and in low - voltage supplies in which the rectifier drop is a significant factor. Fig. 3 is the voltage - drop - versus - current - curve of a Schottky rectifier. For comparison, note that at one ampere the drop is only 0.25 volts, which is even less than that of germanium rectifiers.

You can identify a seleniun rectifier by its stacked plates. And because germanium can be replaced by silicon, positive identification of it doesn't matter. But how to tell a Schottky diode is another matter. If you think it might be a Schottky and it has a brand name printed on it, check the data book of the manufacturer. A 1N — number can always be checked in the various data books. A "house number" can be checked via one of the cross - reference books. Finally, if it's a low - voltage device, and if a stock rectifier results in too much drop, try a Schottky.

Germanium, selenium, and the early silicon rectifiers often developed defects *other than* just complete opens and shorts. But, as stated previously, the majority of failures of modern silicon devices *are* complete shorts and opens, which are easily detected with your VOM. For this reason, there is no sense in devoting a lot of space to the "oddballs," which are newsworthy only because they are so rare.

TUNING DIODES

Also known as "varactors" and "varicaps", these are silicon diodes specially processed for use as voltage - variable capacitors. Any silicon diode with a reverse bias has some capacitance across the junction. The higher the reverse voltage, the smaller the capacitance, as shown in Fig. 4, which is the voltage - versus - capacitance curve for a typical varactor. A "good" varactor has a high "Q" at the frequency at which it was designed to operate.

You will encounter tuning

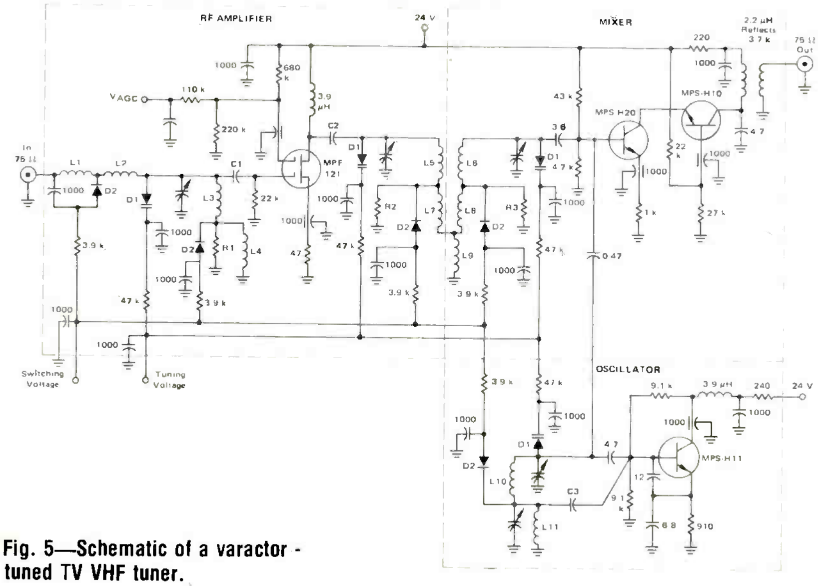


Fig. 5—Schematic of a varactor - tuned TV VHF tuner.

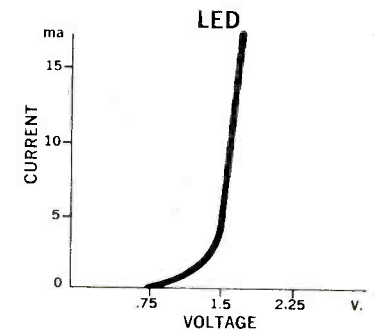


Fig. 6—Current - voltage curve of a light - emitting diode.

diodes in the tuners of 1975 TV receivers made by RCA, Magnavox, Philco, Admiral, General Electric, Quasar, Sylvania and Zenith.

An illustrative schematic of a varactor - tuned TV tuner is shown in Fig. 5. The diodes labeled "D" are the tuning diodes. The bottom of each tuning diode is RF grounded through a 1000 - pfd bypass capacitor and is fed the bias voltage used for tuning through 47K - ohm resistors. The anode end of each diode is returned to ground through its respective coil, completing the DC bias path. In parallel with each tuning diode is a trimmer capacitor for alignment (tracking). You can readily see that it is essential that all diodes have the same capacitance - vs - voltage curve so that they track each other as the bias is changed.

Diodes labeled "D2" are switching diodes, processed to have low forward impedance in the "on" state and high impedance in the "off" state, at the high frequences involved. When forward biased, these diodes bypass a portion of each coil to ground, thus reducing the inductance. This switches the tuner to the high VHF channels (7 through 13). With the diodes in the "off" state, and the entire inductance in use, the varactors cover channels 2 through 6.

Because it is unlikely that you will have a substitute tuning diode in stock, substitution probably will be your last choice of test methods. As with most other types of diodes, tuning diodes can be tested for *gross* defects by measuring forward and reverse conduction with a meter. (Do *not* use the RX1 ohms range because of the high current output it produces.)

To determine if the varactor produces any *tuning* action, first note the normal range of reverse bias applied to the diode, as shown on the schematic of the circuit in which the varactor is used. If no schematic is available, assume, as a start, that the voltage should vary between 2 and 10 volts. In some cases, you can also measure the "normal" circuit bias with the diode disconnected. (However, if the tuning diode is used in an AFC circuit, in which the bias normally changes to tune the circuit to the proper frequency, disconnecting the diode opens the AFC circuit loop, and the bias then changes, making it impossible to determine what the "normal" bias is.)

Once you have determined what the normal bias range is, from a suitable DC bias source apply a substitute bias to the varactor through the isolation impedance of the circuit in which it is used. (Bias normally is applied to a varactor through an RF choke, resistor or other form of isolating impedance.) Varying the bias should produce a visible or audible change in the tuning of the receiver if the varactor is functioning normally.

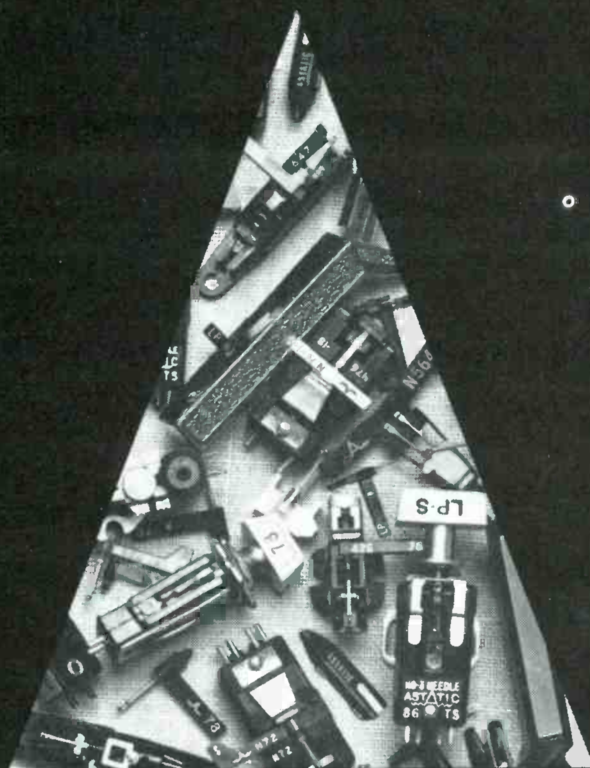
Because tuning diodes normally are not subjected to high stress, they should be long - lived. In most cases, loss of tuning action will be caused by loss of the variable bias applied to the diode; therefore, before pulling the tuner or removing the varactor, it is advisable for the service technician to assume that the diode is okay and look for problems in the circuits which generate the variable bias.

When replacing varactors, either get an original replacement part or else spend the time to make sure that the substitute has the same nominal value, the same voltage - versus - capacitance curve (to avoid upsetting the calibration or tracking of the circuit), and the same Q at the frequency involved. Low - cost substitute units usually do *not* have sufficient Q at high frequencies, but are satisfactory at low frequencies. A TV VHF tuner, for example, demands a unit good through 200 megacycles. Most varactors do not perform well in this range unless specifically designed for it.

LIGHT-EMITTING DIODES

Light - emitting diodes (LEDs) are coming on very strong, replacing pilot lamps and performing many other functions. They emit light when *forward biased,* and normally have either zero voltage (dark) or forward voltage (lighted), and are not used with any appreciable reverse bias.

Fig. 6 shows the relationship between the voltage and current through an LED. Just as with for-



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ward - biased convention diodes, LEDs require a series resistor to limit the current. (Without the series resistance, even a small applied voltage would produce excessive current.)

LEDs normally operate with 15 to 40 mA of current, with higher current producing higher levels of illumination. Currents less than 15 mA do not generally produce sufficient light from all LEDs. (The characteristics of LEDs of the same type vary, and the less efficient ones in each lot might not work well at low currents.) If an LED seems to be defective, check the *current through it*, not the voltage across it. This is illustrated in Fig. 6. Note that a very small increase in voltage near the 1.5 - volt point results in a significant increase in current. From this, it can be seen that voltage measurement is not a reliable method of checking LEDs.

In many circuits, the measured voltage and current might seem abnormally low, yet the LED is lighted. This is caused by the fact that LEDs are often pulsed, with a short pulse, followed by a longer "off" time. This method of operation saves current, because the duty cycle might be only 10 percent or so, but just as in the TV picture itself, the persistency of the human eye produces an apparently flicker - free glow. The meter does not have the persistency of the human eye, and cannot follow the rapid pulsing. It therefore produces a misleadingly low reading.

ZENER DIODES

Zener diodes are operated with *reverse* bias and, like most diodes, can be tested for forward conduction and reverse blocking. (It should be noted that some ohmmeters put out six or more volts on the high - ohms ranges. This might be sufficient to drive a low - voltage zener into reverse conduction.)

The best way to check zeners is in - circuit, operating. If the zener has zero volts or abnormally low voltage across it *and the power source is functioning normally*, the zener is shorted. If there is noticeably higher voltage across the zener than is normal, it is open.

Zeners can become noisy, generating a broad - band noise that gets into everything. Although such noise can be eliminated by bypassing the zener to ground with a capacitor (this has sometimes been recommended as a "quick fix"), it is much better to replace the device. There is a direct relationship between noise and failure rate. Noisy zeners have shorter and more erratic lives than quiet ones.

Sometimes the hot and cold voltage readings on a zener change noticeably, especially in higher - voltage devices. This is because the temperature coefficient of a zener depends on the voltage — under 5 volts the coefficient is negative, around 5 volts it is zero, above 5 volts it is positive. Higher voltage units have a coefficient of about 0.1 percent per degree centigrade. For example, if we are using a 28 - volt power zener, the actual junction might be at 85 degrees centigrade, or 60 degrees above ambient temperature. The 0.1 percent per degree multiplied by 60 degrees equals a 6 - percent change. Six percent of 28 volts is 1.68 volts. Thus, we would have a measurable change of voltage, and the "creeping" would tend to arouse suspicion about the quality of the diode. However, this change is perfectly normal, and is the reason why "compensated zeners" are used for voltage reference applications.

Zeners are available from many manufacturers, and all 1N — numbers are fully interchangeable regardless of who makes them. "House" numbers also are no problem as long as you know the voltage, the wattage, and that it is a single "uncompensated" diode. If it is used as a voltage reference device, use an exact replacement; otherwise, you're in trouble.

SMALL-SIGNAL DIODES

Small - signal diodes are used as RF mixers in front ends, video detectors, FM discriminators, horizontal and color AFPC circuits, bias networks, and in a variety of other applications in receivers.

There are a few types prone to problems, particularly the point - contact devices like 1N34s and the selenium assemblies used in TV horizontal AFPC circuits. The point - contact devices become intermittent because of the junction construction. The life of all selenium devices is shortened by heat and chemical fumes. The vapors from mercury batteries or any other source of mercury vapors literally kill selenium devices.

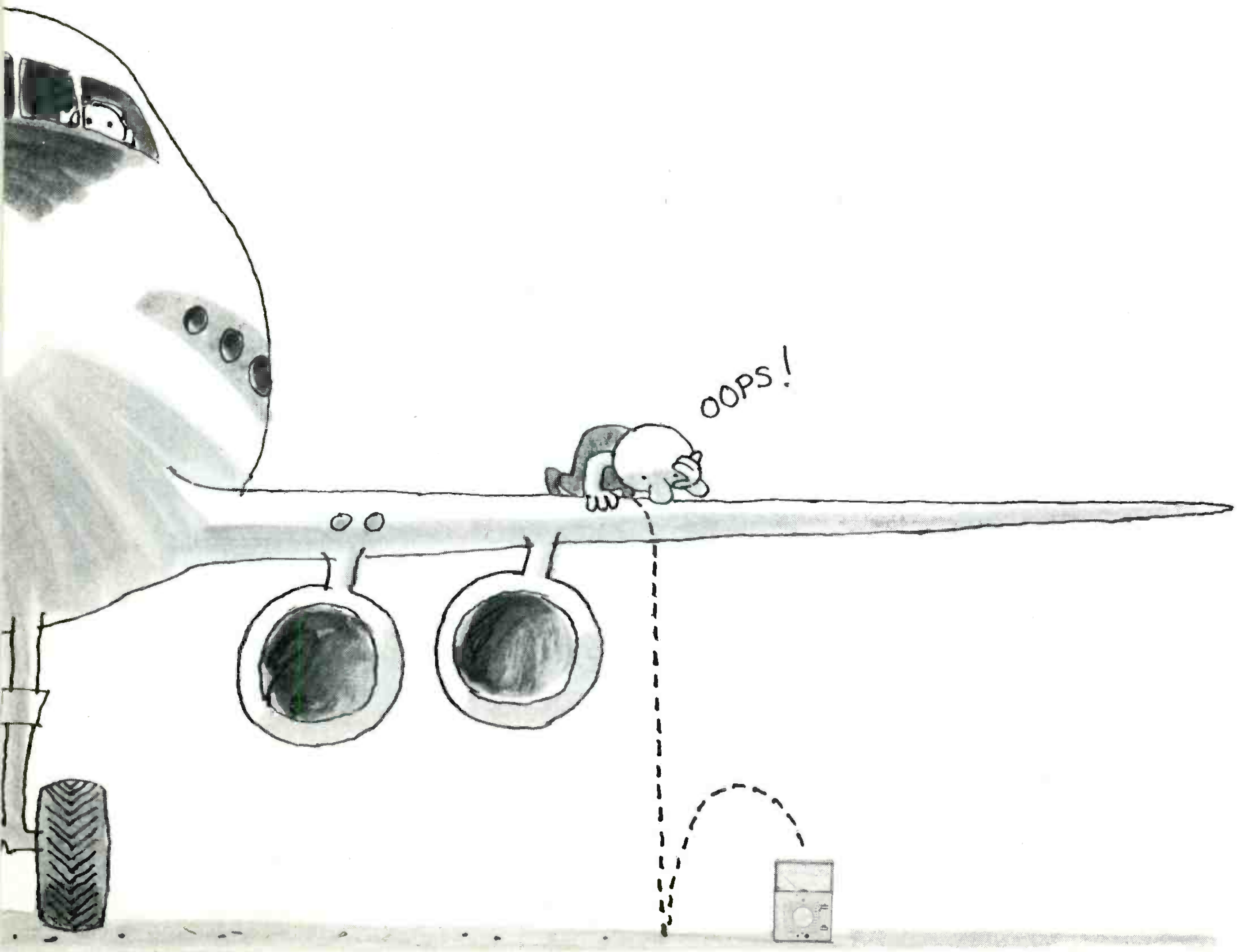
Most silicon small - signal diodes made after 1965 produce little trouble, except when *mechanically* stressed. The biggest problem is caused by mounting signal diodes on PC boards or between terminals without allowing for stress on the leads. Short, straight leads spell trouble. Adding a small dimple in one lead to take up strain and mounting the diode an eighth of an inch off the board eliminates the stress - caused problem.

In small - signal applications there are many types of diodes, and no one type does it all. UHF mixer diodes are not like video detector diodes. The UHF mixer is processed for low noise at small signal levels, while video detectors are designed to handle large signals without distortion. The AFPC diode usually does not operate well at high frequencies, but has closely controlled forward and reverse resistances. As for the common practice of using "whatever works", be smart, use an exact replacement or a guaranteed equivalent. I have encountered UHF tuners which operated after the mixer was replaced only because the set was physically close to the UHF station. When the customer moved, the tuner produced so much snow that the picture was not viewable.

INVENTORY AND PROCUREMENT TIPS

Solid - state has created severe inventory problems for shops which service several makes of sets. In the early days of tubes, they were numbered "PPA", "O1A", etc., in sequence. The number told you nothing about the tube. Many years later, a numbering system was developed which told you a great deal about the tube. A 12SK7, for example, has a 12 - volt filament, seven connec-


WESTON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tions to internal elements, the "K" denotes the area of application, and the "S" indicates it is a single - ended tube. The system was sporadically used, but it nevertheless was a step forward. In Europe, similar attempts were made.

Then, along came solid state — and a great step backward. We began with 1N — and proceeded in sequence, but the *number* means absolutely nothing at all. Later, transistors were, and still are, assigned 2N — numbers in the same meaningless manner. You cannot tell if a 2N device is a bipolar, a junction FET, a MOSFET or an SCR.

There are a few things you can do, however, to help handle the vast number of types of semiconductors (too numerous to stock). Get copies of data books and cross - reference guides from Motorola, GE, Texas Instruments, RCA, etc. They are helpful, and cost little (or nothing) at your local distributor.

You can also reduce the number of type of diodes, for example, by analyzing your needs. High - voltage rectifiers from 400 to 1000 volts can all be replaced by using 1000 - volt, 2.5- or 3 - ampere molded rectifiers. They cost a little more, but, because you are buying them in large quantity, you end up with the same, or less, cost and a smaller inventory.

The low - voltage, high - current devices, such as used in hi - fi equipment, etc., can all be replaced with 6 - ampere, 400 - volt, axial - lead (like a composition resistor) devices.

Full - wave bridges made of four rectifiers in one case pose a problem in only the high - current range. High - current types are expensive and should be ordered only as needed. In a pinch, small bridge rectifiers can be made up of four axial - lead devices, with the leads formed to fit.

Video detectors can be handled by one type in germanium and another in silicon. I can't recommend a specific type without plugging one make or another, but you'll find this an easy one with the help of any substitution guide.

UHF mixer diodes can be handled by two types in the same manner.

LEDs are so new you probably don't have any in stock. They come in different colors, sizes and packages, and for the near future will be special - order items, so don't worry about them. Similarly, other such items should be picked up or ordered on an "as needed" basis during your regularly scheduled parts - ordering routine.

A final word: Get rid of all of your pre - 1965 stock of semiconductors, except for a few of the "odd balls" which are collectors' items. In most cases, these pre - 1965 devices are inferior to contemporary devices. (Old silicon rectifiers, for example, died suddenly when a normal line transient passed through them.) One recall resulting from the use of a pre - 1965 device will cost you more than *dozens* of new semiconductors. ■

TAB book, by permission of TAB BOOKS, Blue Ridge Summit, Pa. 17214
Condensed from a single chapter of a recently introduced

Understanding Scope Specs—Part 1

AC AND DC COUPLING

■ Probably the broadest distinction that can be made between various classes of scopes is between AC and DC scopes. Only DC scopes, those scopes having DC - coupled vertical amplifiers, are capable of measuring DC voltages and DC components of waveforms.

One measurement that can be made with a DC scope, but not with an AC scope, is the battery measurement illustrated in Fig. 1. Notice that the circuit provides a choice of positive, zero, and negative voltages. As the probe of the DC scope is moved downward in the circuit of Fig.1, the trace shifts downward, as shown by Figs. 1B, C, and D. This type of setup can be used to calibrate a scope not only for DC measurements, but for peak - to - peak AC measurements as well. Once a good DC scope is calibrated in terms of DC volts, the same calibration holds good for AC measurements.

In displaying a sine wave at the collector of a transistor audio amplifier, we obtain a waveform of the type shown in Fig. 2. Since a DC voltage is applied to the collector of the transistor, the sine - wave signal at the collector has a DC component, which is shown as a vertical displacement on a DC scope and in Fig. 2. In displaying with a DC scope the video signal output of the second detector of a television receiver, we see, as in Fig. 3, that this signal has a DC component also. Other signals that the DC scope is very useful for displaying are the very low - frequency signals encountered in industrial electronics work, since the DC scope does not attenuate these signals.

DC - coupled amplifiers differ from AC - coupled amplifiers in that the DC - coupled amplifiers use no coupling capacitors between stages. That is, they use no coupling capacitor between the collector or plate of one stage and the base or grid of the succeeding stage. Thus, DC voltage changes are transferred from the collector or plate of one stage to the base of grid of the next, and are amplified just as AC signals are. In an AC - coupled amplifier, on the other hand, the coupling capacitors used between the stages block DC voltages and prevent the amplification of DC voltage changes.

Direct coupling in a vertical amplifier is not achieved without cost. DC - coupled amplifiers are more elaborate than their AC counterparts, because balanced circuits are generally required to prevent drift. Drift causes a slow movement of a display on the screen, and arises from the amplification of minute changes of DC voltages in early stages of a DC amplifier. In AC

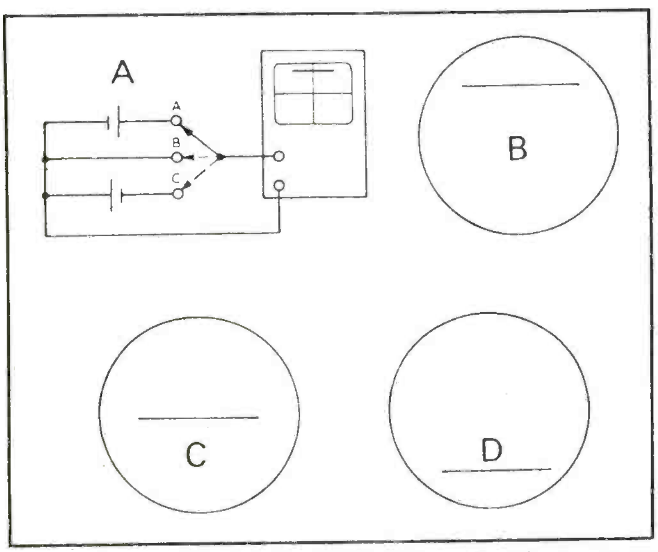

Fig. 1—DC - coupled scope is capable of measuring DC voltages, as illustrated here.

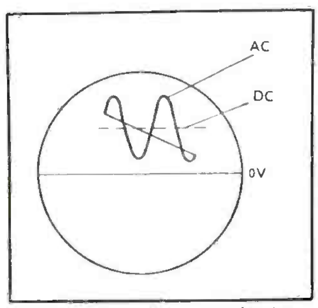

Fig. 2—Illustration which shows that the sine wave on the collector of an amplifier has a DC component.

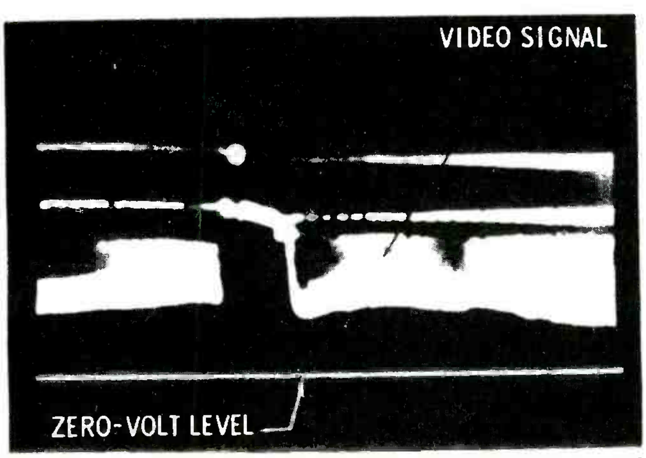

Fig 3—Waveform at the output of a TV video detector. DC component of waveform shifts it above zero level on the DC scope screen.

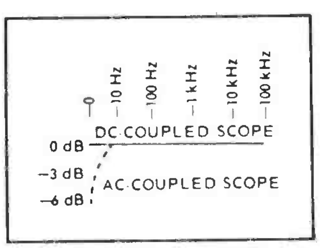

Fig.4—Increasing capacitive reactance of coupling capacitors causes the vertical amplifier response of an AC scope to drop off at lower frequencies.

(From Chapter 7, UNDERSTANDING & USING THE OSCILLOSCOPE, By Clayton Hallmark, TAB BOOKS, Copyright 1973. A review of the complete book follows part 2.)

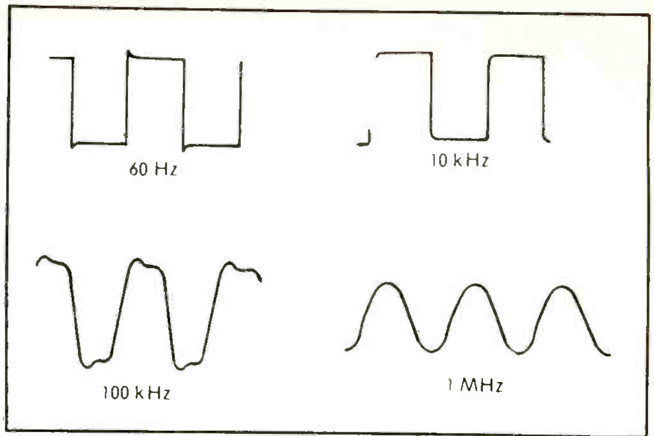

Fig. 5—How square waves of various frequencies are displayed by a 100 - KHz scope.

amplifiers this problem is precluded by the fact that DC changes are not amplified. When drift is not counteracted, frequent readjustment of the centering controls are required.

Because of the balanced circuits required to minimize drift in a DC amplifier, it may have twice as many transistors or tubes as an otherwise equivalent AC - coupled amplifier. One bonus of the balanced circuits employed in DC amplifiers is that such amplifiers are less susceptible to instability caused by line - voltage fluctuations. Besides balanced circuitry, DC amplifiers also often use negative feedback to counteract drift. A bonus derived from negative feedback in DC - coupled amplifiers is that it results in improved amplifier linearity and less distortion of signals applied to the amplifier.

In addition to preventing amplification of DC voltages, the coupling capacitors of AC amplifiers adversely affect low - frequency response. That is because capacitive reactance increases as frequency decreases. The effect of coupling capacitors on low - frequency response in an AC - coupled amplifier is illustrated in Fig. 4. Low - frequency response can be improved by using relatively high values of coupling capacitance, but there is a practical limit to how far this can be carried.

Although some scopes having DC - coupled vertical amplifiers also have DC - coupled horizontal amplifiers, many do not. However, identical vertical and horizontal amplifiers, are desirable for making phase - shift measurements with a scope, to insure that the scope does not itself cause a phase difference between the vertical and horizontal signals. Often, in a scope with identical vertical and horizontal amplifiers, the vertical amplifier will have greater amplification even though it has the same frequency and phase characteristics as the horizontal amplifier, but this causes no problem in phase - shift measurements.

VERTICAL AMPLIFIER BANDWIDTH

Another broad classification of scopes separates the narrow - band and wide - band scopes. Scopes considered to have narrow - band response generally cover the AF range. Those having wide - band response usually have vertical amplifiers that are fairly linear over the video frequency range, out to

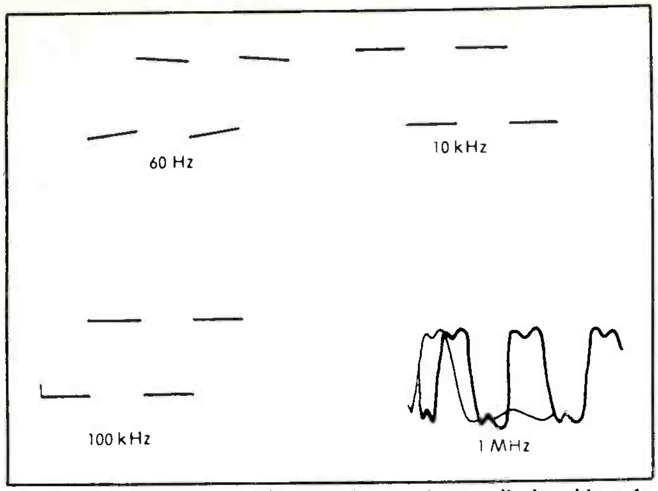

Fig. 6—How square waves of various frequencies are displayed by a 4 - MHz scope.

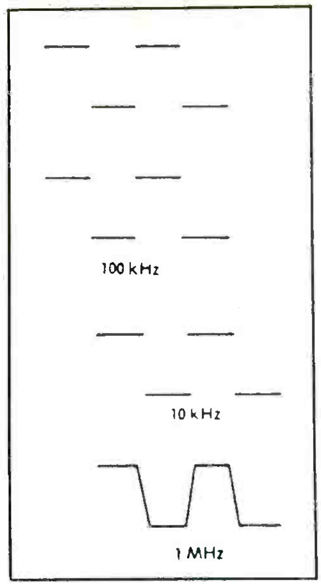

Fig. 7—How square waves of various frequencies are displayed by a 15 - MHz scope.

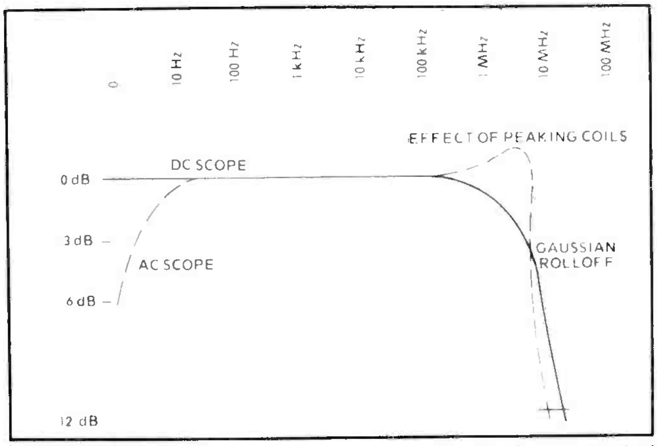

Fig. 8—Typical frequency response curves for AC and DC scope vertical amplifiers.

about 5 MHz. The wide - band scopes may have DC - or AC - coupled amplifiers. Laboratory scopes, the expensive scopes used in industrial electronics work, may have either narrow - band or wide - band response, but they very often feature extended high - frequency response, to hundreds of megahertz. Other features of lab - type scopes will be discussed later, since such instruments are becoming more common all the time.

The bandwidth of the vertical amplifier has a great bearing on the usefulness of a scope, especially for viewing nonsinusoidal waves. It also has a great bearing on the cost; usually, the greater the bandwidth, the greater the cost of the scope.

One of the most important changes in the design of scopes in recent years has been an increase in the bandwidth of the vertical and horizontal amplifiers. The need for increased bandwidth is based on the types of waveforms that have become standard in recent years. Many modern devices make use of square, triangular, sawtooth, and various pulses and other nonsinusoidal waveforms. The display of these waveforms requires much higher frequency response than the display of sine waves.

An illustration of the ability of scopes with various band - widths to display complex waveforms is given in Figs. 5 through 7. Notice in Fig. 5 that a scope with a 100 KHz bandwidth is not able to give a good representation of a 100 KHz square wave. This is because the harmonics in the square wave are attenuated by the vertical amplifier. They lie far outside the passband of the amplifier. A 1 MHz square wave is reproduced virtually as a sine wave.

Notice that in Fig. 6 the 4 MHz scope is seen to give a good reproduction of the 100 KHz square wave, but that it badly distorts the 1 MHz square wave. Only the fundamental and the third harmonic of the 1 MHz square wave lie within the passband of the 4 MHz scope.

As can be seen in Fig. 7, a 15 MHz lab - type scope is able to give a good reproduction of the 1 MHz square wave. The fundamental of the 100 MHz square wave and the next six odd harmonics are within the passband of the 15 MHz scope. These frequency components are enough to produce a fairly decent square wave.

The frequency response curve of a 5 MHz scope is shown in Fig. 8. This is a curve of the *sine wave* response of the scope's vertical amplifier. The solid curve shows the response of a DC - coupled amplifier, while the dotted curve shows the response for an AC - coupled amplifier. Notice that the response of a direct - coupled amplifier goes right down to DC.

The frequencies where the output drops to 3 dB below the linear portion of the curve are indicated in Fig. 8. At these frequencies, the output sine - wave voltage falls to 70.7 percent of the midfrequency sine - wave voltage. The bandwidth of the amplifier is, by definition, the difference between the upper and lower 3 - dB - down frequencies. For a DC - coupled amplifier, the bandwidth is simply the same as the upper 3 - dB - down frequency. In Fig. 8, this frequency is 5 MHz.

As far as the faithful reproduction of square waves and very brief pulses (transients) is concerned, the high end of the frequency response curve is most important. The shape, or "rolloff," of the high end should, ideally, be as shown by the solid line in Fig. 8. That is, the high frequency should roll off, or fall off, according to a curve known as a *gaussian* curve. If it does, the 3 dB point will be approximately half the 12 dB frequency. If the upper 3 dB point is 5 MHz, the 12 dB point should be 10 MHz. Lab - grade scopes usually do have a gaussian rolloff. Another thing the response curve should have is a reasonably flat top, within a couple of decibels, to keep some frequencies from being accentuated and distorting the waveform.

In some tube - type scopes, inductances are inserted in the plate circuits of tubes in the ver-

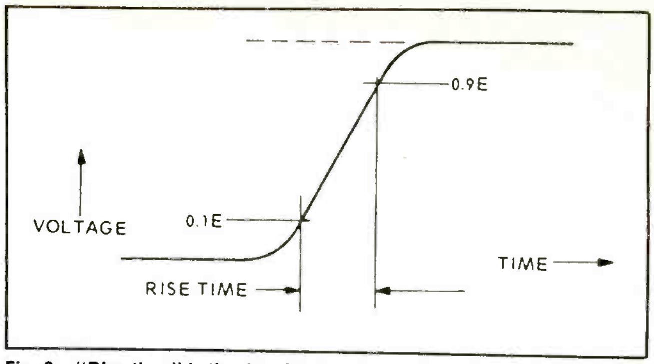

Fig. 9—"Rise time" is the time it takes the leading edge of a square wave to rise from 10 percent to 90 percent of its maximum amplitide.

tical amplifier circuits to compensate for interelectrode capacitances and wiring capacitances that tend to shunt high frequencies to ground. This extends the high - frequency response of the vertical amplifier, but causes the response curve to peak at its high end, as shown in Fig. 8. For this reason, the inductances inserted for high - frequency compensation are termed *peaking coils*. The peak in the response curve occurs at the frequency at which the peaking coil resonates with the tube and stray capacitances.

You can use a signal generator having a flat output to check the response of your scope. If you find that the scope has too fast an upper - end rolloff, it probably uses peaking coils.

RISE TIME (TRANSIENT RESPONSE)

For an amplifier to faithfully reproduce pulses with steep leading edges, the amplifier must permit a very rapid rise in voltage. In a vertical amplifier, this allows the CRT beam to deflect very rapidly and to follow the nearly vertical edge of a steep pulse. This characteristic of the vertical amplifier is known variously as *rise time, transient response*, and *time response*. It is expressed by a number that is actually an interval of time. Before the rise time, or transient response, of a vertical amplifier can be well understood, it is necessary to understand the steep - sided pulses whose observation depends on this characteristic.

For precision in describing the steepness of the leading edge of a pulse such as a square wave, it is desirable to be able to express the steepness in numbers. This need leads us to the concept of the rise time of a wave, defined as the time required for the leading edge to rise from 10 percent of the peak value to 90 percent of the peak value. This is illustrated in Fig. 9.

Although the above definition is the generally accepted one, rise time is occasionally taken as the time required for the leading edge to rise from 5 percent of the peak value to 95 percent of the peak value. However, if this or any other definition other than the one given in the preceding paragraph is intended, the intended definition is given along with the rise time.

The rise time of a device that transmits waveforms or displays them is taken as the rise time of the displayed waveform resulting from a theoretically perfect square - wave input. A perfect square wave is impossible to obtain in practice, of course.

continued next month

Wayne Model WT2A Transistor/Diode Tester

By Joseph Zauhar

■ Although transistor testers have been available for years, each time we review and actually operate a new transistor tester we find new, unique and interesting features.

Transistor testing has become so simplified compared to earlier methods that most transistors can be tested in seconds without any specifications on the transistor, and as we make the test they are automatically found.

General Description

The Wayne Model WT2A Tester (Fig. 1) which we reviewed provides both in - and out - of - circuit testing of transistors by measuring the resultant DC voltage drops of a rectifying junction.

It applies a precise AC voltage, through a current limiting resistor, to the diode junction under test. The DC voltage is then monitored across the junction while it passes the normal rated current. This same voltage drop occurs across most transistors and diodes regardless of power applications.

The tester will check for leakage, emitter - to - collector shorts, emitter - to - base and base - to - collector shorts, emitter - to - base and base - to - collector diode characteristics, linearity, and relative gain. It also locates the base and collector terminals of the transistor during the testing procedure.

The instrument will test transistors, signal diodes, power diodes, zener diodes, tunnel diodes, Darlington transistors, MOSFET's, and thyristors (SCR). Any semiconductor device that contains one or more silicon or germanium diodes, such as the photo transistor and unijunction transistor, can be tested by using the DIODE testing concept of the unit.

The various transistor or diode tests can be selected by a rotary six - position TEST selector

For more information about this test instrument, circle 145 on the Reader Service Card.

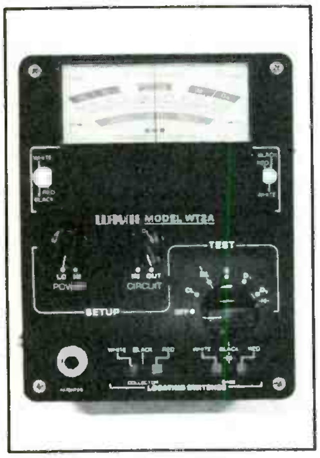

Fig. 1—Wayne Model WT2A Transistor/Diode Tester.

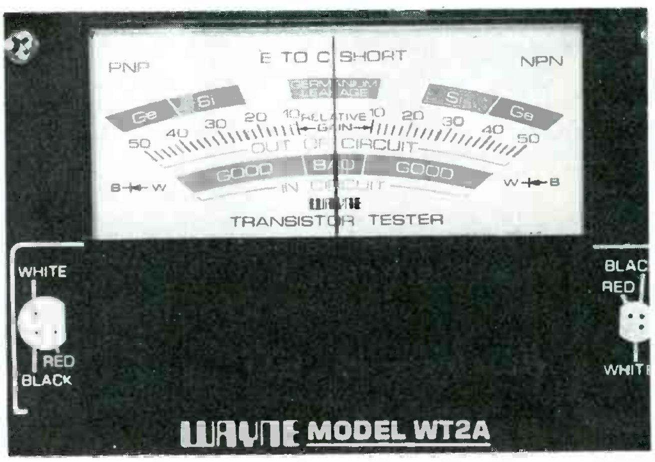

Fig. 2—Three easy - to - read scales provide: In - Circuit, Out - of - Circuit and Relative Gain readings.

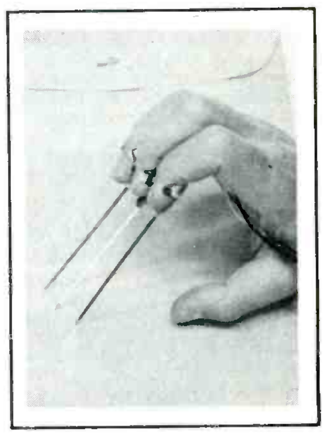

Fig. 3—The finger probe test leads, leave the left hand free to operate the instrument.

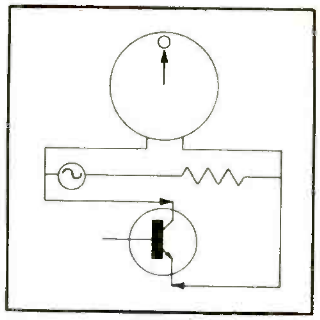

Fig. 4—Leakage Test.

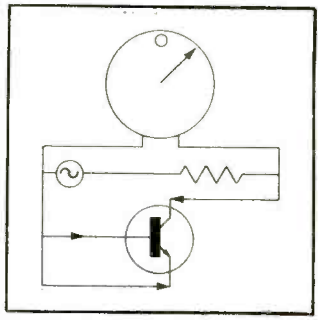

Fig. 5—Short Test (E to C).

switch located on the front of the tester.

A sensitive zero center DC voltmeter (Fig. 2) indicates the condition and the type of component under test (one - half volt full scale). This meter provides three easy - to - read scales: In - Circuit, Out - of - Circuit and Relative Gain.

Two plug - in transistor sockets on the front of the tester simplify out - of - circuit transistor testing by eliminating the need for the test leads. The Wayne Model WT2A Transistor Tester is priced at $159.95.

Test Leads and Finger Probe

Two sets of color - coded test leads are included with the tester and, because they are connected in a parallel configuration, may be used independently or together for those hard - to - reach places.

The unique finger probes (Fig. 3) are put on the three center fingers of the right hand, with the test lead cable on the palm side of the thumb and little finger. At first, the probe seemed a little awkward, but after a little practice we had very good control of the probes on small circuit boards. Apply just enough pressure on the sharp needle points to pierce through the insulative coating on the circuit board.

Circuit Description

The circuit in the transistor tester consists of a 60-Hz, 1.33 - volt AC RMS power supply, the output voltage of which is applied directly to the component under test. Two SETUP switches (Fig. 1) located on the front of the instrument allow the selection of different current - limiting resistances to provide the needed current for a wide range of test conditions.

The tester circuitry is connected to the transistor under test by an automatic BASE LOCATING switch which allows connecting of the test leads to the transistor without knowing the terminal diagrams. A switch is provided to locate the collector lead and, at the same time, measure the relative current gain of the transistor. The relative gain may be converted to beta by using the graph provided in the instruction book.

Transistor Testing

1) Apply AC power to the tester.

2) Connect the three clip leads of the tester to the transistor leads or plug into the socket on the front panel of the tester.

3) Set the power switch in the LO position for low - power components or HI position for high - power components.

4) Set the CIRCUIT switch in the appropriate

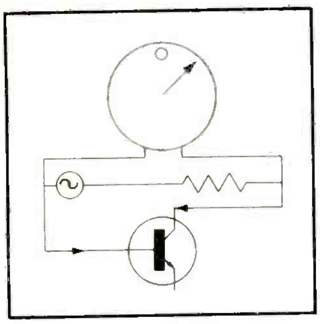

Fig. 6—Diode Test (D_1).

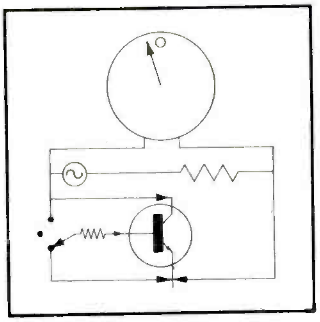

Fig. 8—CL/Gain Test.

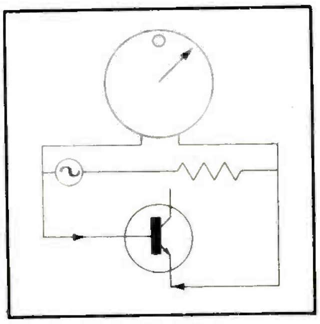

Fig. 7—Diode Test (D_2).

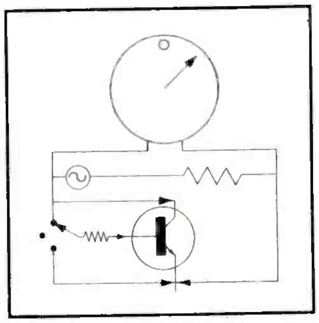

Fig. 9—CL/Gain Test.

in or out position.

5) Place the TEST switch to the BL position for base locating and leakage.

6) Set the BASE LOCATING slide switch to the position that indicates a center - scale or near - the center - scale reading on the meter. The transistor sockets and test leads are color coded to indicate the base with respect to the position of the slide switch. (Emitter - to - base and base - to - collector diode tests and base locating.)

7) If more than one position of the slide switch provides a center - scale reading, the transistor is defective. The one position that produces a center - scale or near - center - scale reading is the test for leakage. Only out - of - circuit leakage tests are reliable and the older type power germaniums may show leakage up to the limits of the leakage zone. Silicon transistors should show no leakage at all. Use your judgment based on experience as to the acceptable amount of leakage for germanium transistors, or compare the amount of leakage of the one in question to that of a known good one.

8) Move the TEST switch to the S position. (Emitter - to - collector short test.)

If the meter does not deflect from center scale, the transistor is defective. Although the transistor is known to be defective, the D1 and D2 positions may be checked to determine, in most cases, whether the defective transistor is PNP or NPN, and whether it is a germanium or silicon type. (Make sure the test lead plug is all the way in to the *second* snapped - in position.

9) Move the TEST switch to the D1 and then the D2 position. Compare the readings. (Out - of - circuit only.) Diode junctions were tested in step 7 for open or shorted conditions. Now test for uniformity. If they do not have the same reading, amplitude distortion will result in a linear amplifier stage.

10) Move the TEST switch to the CL position for collector locating and relative gain test.

11) Set the COLLECTOR LOCATING slide switch to the position that offers the most deflection. The transistor sockets are labeled and the test leads are color coded to indicate the collector with respect to the position of the slide switch. (The COLLECTOR LOCATING switch is not dependable in some output stages.) Relative gain is indicated by the amount of deflection after the collector has been located. This can be converted to beta by using the gain scale graphs. (Only out - of - circuit gain tests are reliable.)

Test Circuit Configurations

The six simplified schematic basic test configurations illustrate the connections to the transistor terminals for various tests.

When making the Leakage Test (Fig. 4), the BASE LOCATING slide switch disconnects the base and connects the emitter and collector terminals. Good silicon transistors do not show leakage. Older type power germaniums may show leakage to the limits of the leakage zone on the meter scale.

During the shorts test of a transistor, (Fig. 5) the BASE LOCATING SLIDE switch stays in the same position as in Fig. 4. The rotary TEST switch is moved to the S position (shorts). If there is no meter deflection, the transistor is defective.

When making diode tests, Fig. 6 & Fig. 7, the BASE LOCATING slide switch stays in the same position as in Fig. 4. The TEST switch is moved to D_1, and then to D_2. The DC voltage drop of a rectifying junction and tests for transistor linearity by comparing the two.

The gain tests shown in Fig. 8 & Fig. 9 are made by moving the TEST switch to the CL position. This setup allows the collector of the transistor to be located by the position of the slide switch that offers the most deflection. The amount of deflection is related to the gain of the transistor.

Conclusion

We felt that the Wayne Model WT2A was quite accurate after checking a number of both good and defective transistors. Most of the transistors were checked without specifications and the simplified setup procedures could save many hours of service time. ■

NEW PRODUCTS...

continued from preceding page

dB ± 9 MHz from channel center. Output return loss is at least 18 dB. Completely solid - state, the amplifiers utilize triple tuned input bandpass filters for sharp selectivity and lightning protection. A combination of double - tuned output bandpass and band reject

filters permit direct coaxial jumper mixing of non - adjacent channels. Designed for 19 - inch rack mounting, they can also be wall or panel mounting by means of reversible brackets. The price of the JHPM is $145.50; the THPM is $230.00 for regular channels and $254.00 for midband channels. The SHPM is $276.50.

MULTIMETER 148

Voltage range protection of up to 2 kv, automatic polarity with indication, and linear scales for all ranges are the major features of the new in-

tegrated - circuit - equipped multimeter announced by *Philips Test & Measuring Instruments, Inc., a subsidiary of North American Phillips Corp.* The Model PM2503 Multimeter has a minimum 10 - Megohm input impedance and provides virtually no - load measurements at 3 - percent accuracy. The circuitry allows linear scales to be used for all measurements except dB. Additional features of the unit allow separate readings of DC and AC components of measured signals. Automatic polarity with polarity indication, pushbutton AC/DC selection, single rotary range selection and V - Ohm on the same input sockets all combine to make measurements convenient and almost error - free. The instrument has AC/DC current ranges of 1 microamp to 1 a, AC/DC voltage ranges of 100 mv to 1 kv and resistance ranges of 100 ohm to 10 Megohm. No zeroing or infinity adjustments are required on the multimeter, which uses standard 9 - volt batteries. Price is $169.

TWO-WAY RADIO BASE STATIONS 149

Electronic packaging technology gives *General Electric's* new solid state MASTR II two - way radio base stations an uncluttered design leaving room in cabinets to add options and accessories. More than 70 options are available. Two indoor cabinets are approximately 30 and 44 inches in height, 21 inches wide and 15 inches deep. A third indoor cabinet is 69 inches high, 23 inches wide and 21 inches deep. A gasketed weatherproof

outdoor cabinet, for wall, pedestal, or pole/crossarm mounting, is 45 inches high, 21.5 inches wide and 21 inches deep. A swing - down shelf inside the unit provides quick access to all circuits simplifying routine checks and service. Microelectronic thick film hybrid integrated circuits are used extensively and contribute to compactness, reliability and serviceability.

COAXIAL CABLE CLIPS 150

Electrovert, Inc., announces the introduction of a dual clip for securing two paralleled RG59 coaxial cables. The parallel RG59 coaxial cables. The clips are molded of high - impact, shatter - proof polystyrene. A captive cadmium plated hardened steel nail secures the clip to wood, brick, mortar or plaster surfaces. The dual contoured design provides support without crushing the cable. This is particularly important in mounting coaxial cables for CATV systems. The clips are available in gray, black and natural colors. Price is $39.75/M. ■

DEALER SHOWCASE

Descriptions and specifications of the products included in this department are provided by the manufacturers. For additional information, circle the corresponding numbers on the Reader Service Card in this issue.

VEHICLE ALARM 160

The *Wolo* Sure Safe MACH 4 alarm can be installed in any vehicle in a very short time. Designed with solid - state circuits, the unit insures accurate timing and the monitoring of all battery current flow. A hidden switch

within in vehicle activates the system and must be turned off within 15 seconds after entering the vehicle, or the 114 - dB siren will sound.

CASSETTE STEREO RECORDER 161

A cassette stereo recorder deck with switchable capability to use three different kinds of tape is now available from *3M/Wollensak*. The Model 4766 uses regular tape, chromium dioxide, or ferri - chrome (Scotch brand "Classis") tape, matching the bias characteristics of the machine to those of the tape. Other features of the cassette deck include: peak indicator lights for

each stereo channel, VU meter for each channel, Dolby patented noise - reduction circuitry, and the dual - direct drive mechanism. Price is $429.95.

RECORD CHANGER/TURNTABLE 162

Technics by Panasonic introduced the Model SL - 1330, the first automatic direct - drive record changer/turntable. The direct - drive, brushless DC motor has been combined with the convenience of a fully automatic, multi - play, record changing mechanism. The tone arm features two - way damped cueing and precise anti - skating adjustment, as well as low tracking - angle error and the use of the universal system for positive and easy cartridge - shell insertion. The aluminum die - cast turntable platter, which is dynamically balanced, weighs 3.86 lbs. Raised dots along its outer flange permit stroboscopic check at either of the two speeds

available, 33⅓ and 45 RPM. Other features include: Memo - Gram, which permits the user to set the turntable for changer operation or repeat play; and the ability to put the turntable immediately into the shut - off model without having to play through all the records already in the stack. Price is $349.95.

RESIDENTIAL FIRE DETECTOR 163

A detector that senses smoke and fire in the home and sets off a loud alarm to warn residents has been introduced by *Honeywell*. The fire detector uses an ionization principle in which the presence of invisible products of combustion is sensed before smoke or flame, which come later in the development of a fire. Tests in an actual mobile home research facility

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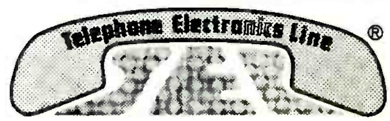

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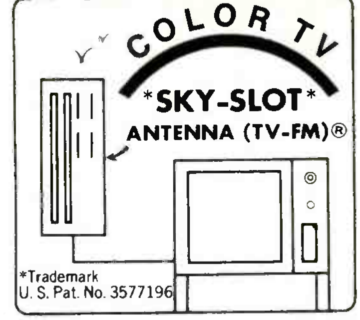

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TEKFAX

COMPLETE MANUFACTURER S' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS

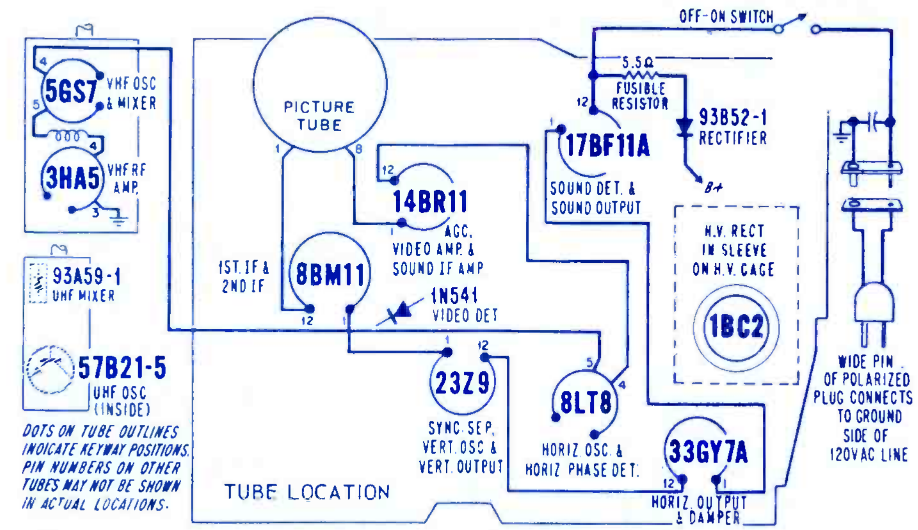
GROUP 271

1573

ADMIRAL

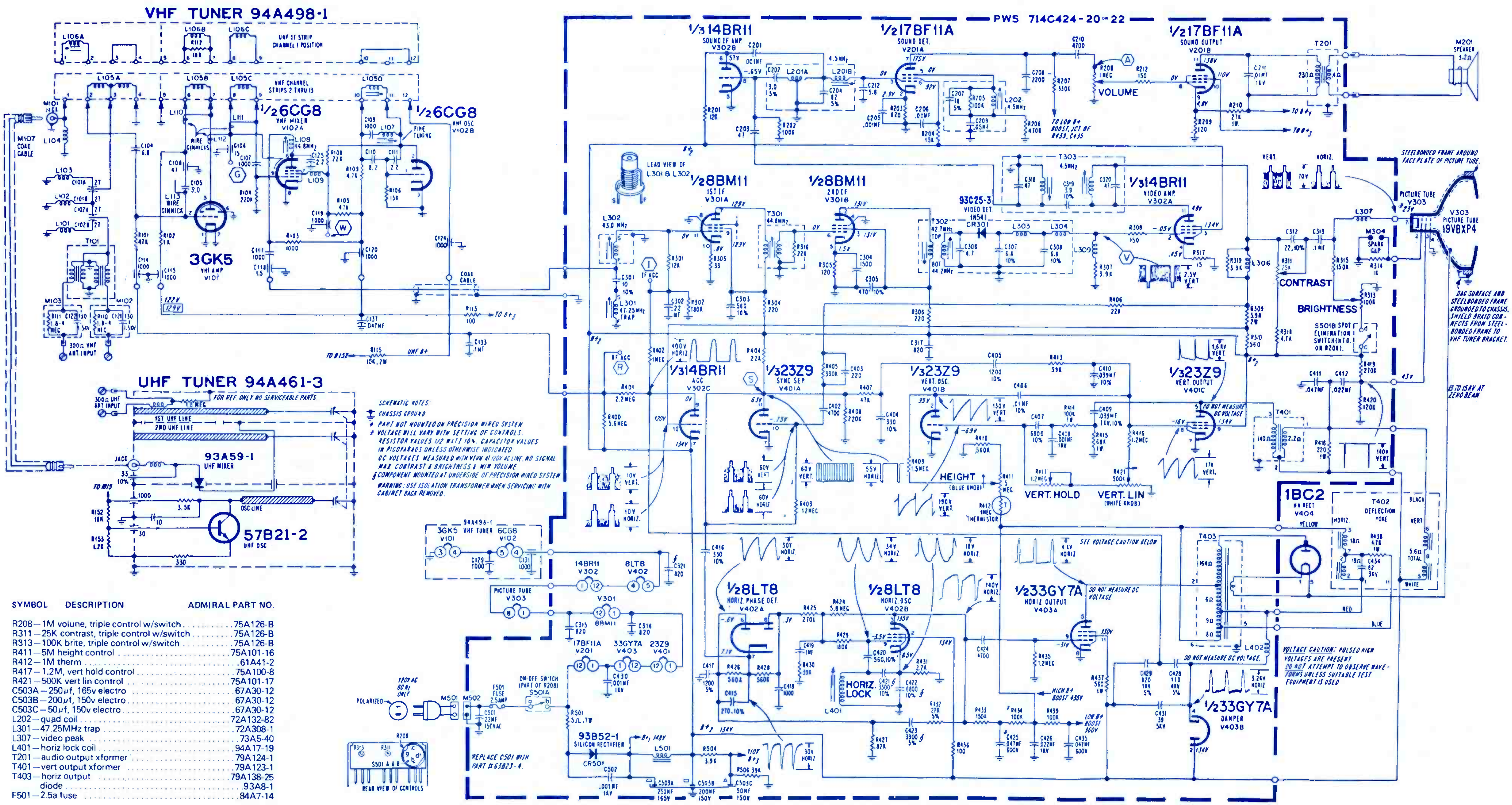
TV Chassis T35H4-2B

MARCH • 1975



RUN CHANGES.

(10) Start of production



SYMBOL	DESCRIPTION	ADMIRAL PART NO.
R208	1M volune, triple control w/switch	75A126-B
R311	25K contrast, triple control w/switch	75A126-B
R313	100K brite, triple control w/switch	75A126-B
R411	5M height control	75A101-16
R412	1M therm	61A41-2
R417	1.2M, vert hold control	75A100-8
R421	500K vert lin control	75A101-17
C503A	250µf, 165v electro	67A30-12
C503B	200µf, 150v electro	67A30-12
C503C	50µf, 150v electro	67A30-12
L202	quad coil	72A132-82
L301	47.25MHz trap	72A308-1
L307	video peak	73A5-40
L401	horiz lock coil	94A17-19
T201	audio output xformer	79A124-1
T401	vert output xformer	79A123-1
T403	horiz output	79A138-25
	diode	93A8-1
F501	2.5a fuse	84A7-14

1574

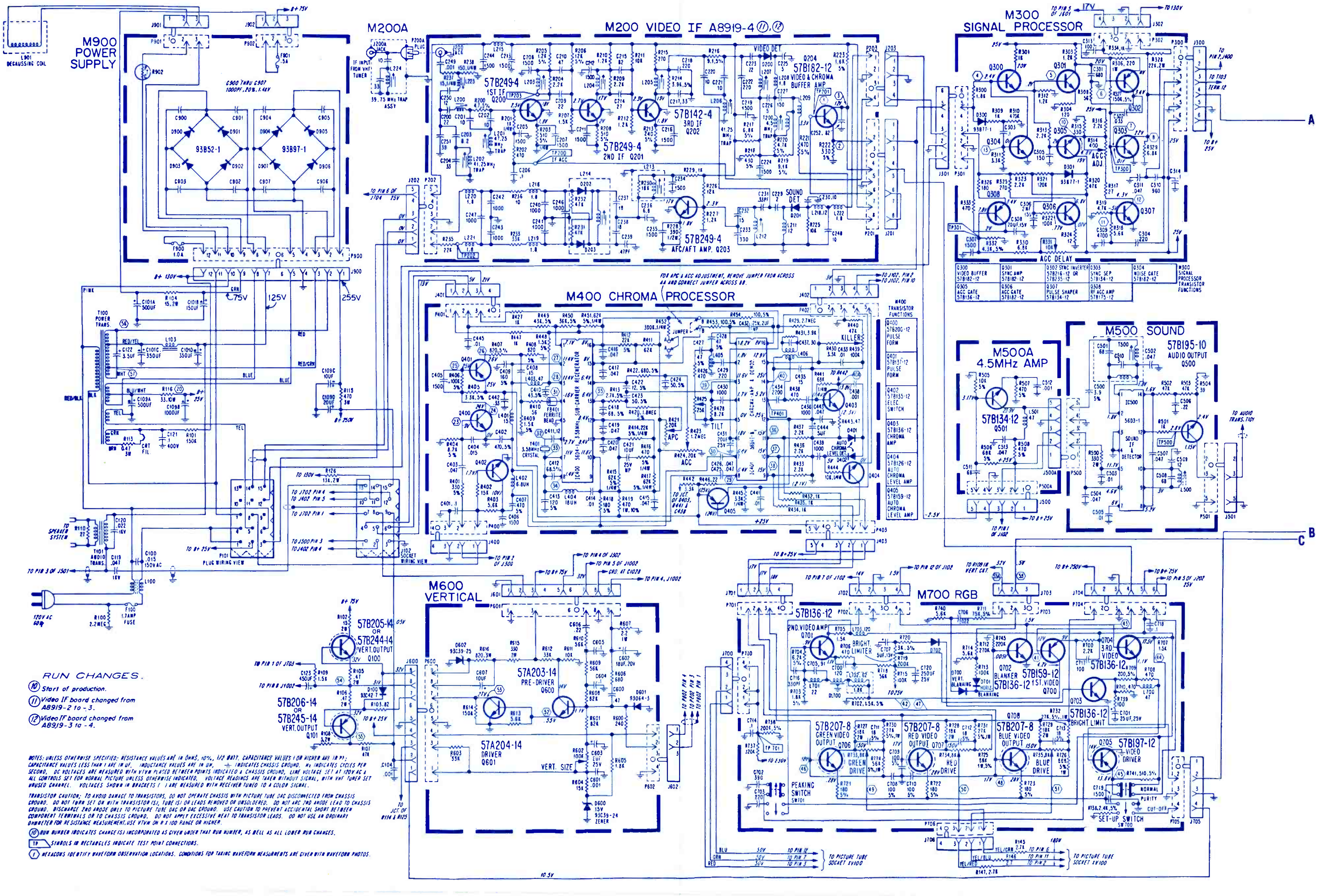
ADMIRAL

Color TV Chassis
1M30

ELECTRONIC TECHNICIAN/DEALER TEKFAX

MARCH • 1975

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS



RUN CHANGES.

(10) Start of production.

(11) Video IF board changed from A8919-2 to -3.

(12) Video IF board changed from A8919-3 to -4.

NOTES: UNLESS OTHERWISE SPECIFIED: RESISTANCE VALUES ARE IN OHMS, 10%, 1/2 WATT. CAPACITANCE VALUES 1 OR HIGHER ARE IN PF; CAPACITANCE VALUES LESS THAN 1 ARE IN UF. INDUCTANCE VALUES ARE IN UH. ⏚ INDICATES CHASSIS GROUND. Hz INDICATES CYCLES PER SECOND. DC VOLTAGES ARE MEASURED WITH VTVM PLACED BETWEEN POINTS INDICATED & CHASSIS GROUND, LINE VOLTAGE SET AT 120V AC & ALL CONTROLS SET FOR NORMAL PICTURE UNLESS OTHERWISE INDICATED. VOLTAGE READINGS ARE TAKEN WITHOUT SIGNAL, WITH VHF TUNER SET UNUSED CHANNEL. VOLTAGES SHOWN IN BRACKETS ( ) ARE MEASURED WITH RECEIVER TUNED TO A COLOR SIGNAL.

TRANSISTOR CAUTION; TO AVOID DAMAGE TO TRANSISTORS, DO NOT OPERATE CHASSIS WITH PICTURE TUBE DAG DISCONNECTED FROM CHASSIS GROUND. DO NOT TURN SET ON WITH TRANSISTOR(S), TUBE(S) OR LEADS REMOVED OR UNSOLDERED. DO NOT ARC 2ND ANODE LEAD TO CHASSIS GROUND. DISCHARGE 2ND ANODE ONLY TO PICTURE TUBE DAG OR DAG GROUND. USE CAUTION TO PREVENT ACCIDENTAL SHORT BETWEEN COMPONENT TERMINALS OR TO CHASSIS GROUND. DO NOT APPLY EXCESSIVE HEAT TO TRANSISTOR LEADS. DO NOT USE AN ORDINARY OHMMETER FOR RESISTANCE MEASUREMENT. USE VTVM ON R X 100 RANGE OR HIGHER.

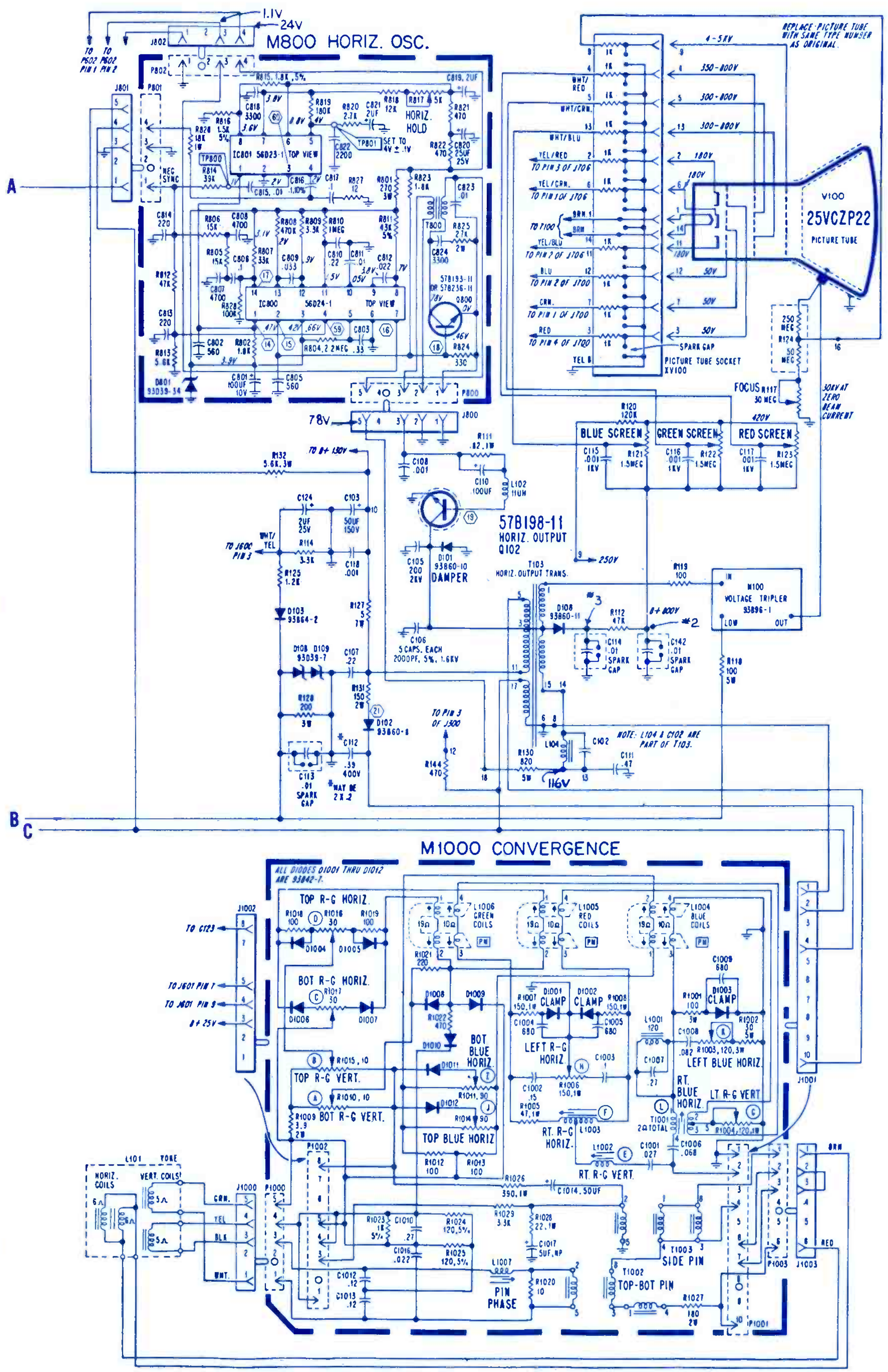
(10) RUN NUMBER INDICATES CHANGE(S) INCORPORATED AS GIVEN UNDER THAT RUN NUMBER, AS WELL AS ALL LOWER RUN CHANGES.

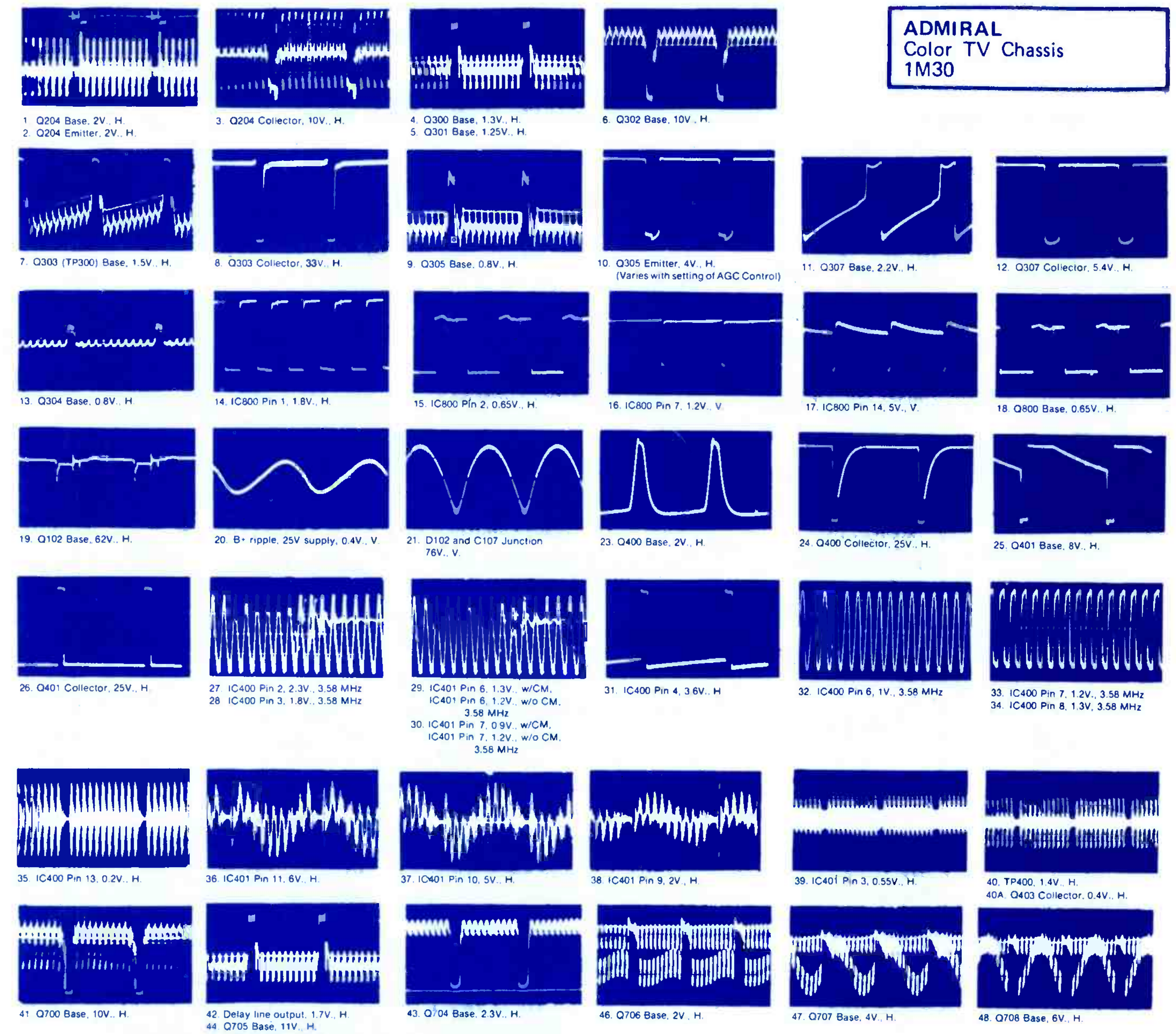
TP SYMBOLS IN RECTANGLES INDICATE TEST POINT CONNECTIONS.

(1) HEXAGONS IDENTIFY WAVEFORM OBSERVATION LOCATIONS. CONDITIONS FOR TAKING WAVEFORM MEASURMENTS ARE GIVEN WITH WAVEFORM PHOTOS.

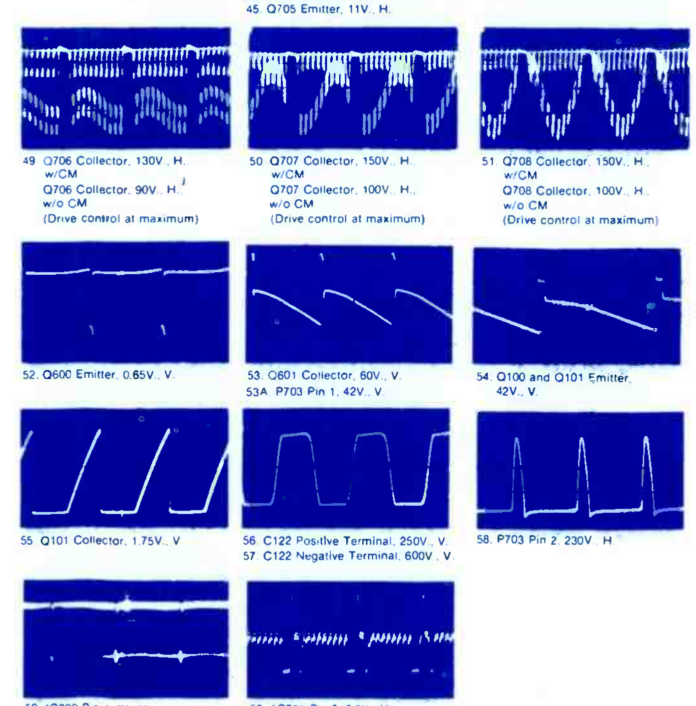
SYMBOL	DESCRIPTION	ADMIRAL PART NO.
R124	focus module	61A72-1
C101A, B, C, D	350µf/200v, 350µf/200v, 150µf/100v, 500µf/100v electro	67A15-421
C109A, B, C, D	500µf/500v, 1000µf/35v, 300µf/15v, electro	67A15-430
R439	100K, color killer	75A101-63
R719	200K, brite limiter	75A101-28
R602	100K, vert size	75A101-60
R117	30M, focus control	75A108-8
R129	6K vert center control	75A64-53
R817	5K, horiz hold	75A101-64
L406	coil, chroma bandpass	73A137
L100	choke, AC line	73A31-22
T100	xformer, power	80A125-4
T101	xformer, audio	79A141-1
T103	xformer, horiz output	79A177-3
L500	coil, quad	72A329-1
F100	fuse, 1.7a	84A28-6

ADMIRAL
Color TV Chassis
1M30



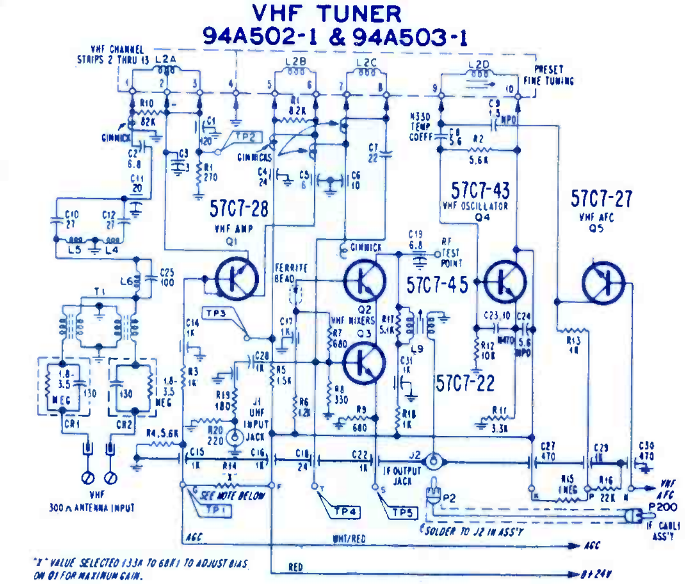


1. Q204 Base, 2V., H.
2. Q204 Emitter, 2V., H.
3. Q204 Collector, 10V., H.
4. Q300 Base, 1.3V., H.
5. Q301 Base, 1.25V., H.
6. Q302 Base, 10V., H.
7. Q303 (TP300) Base, 1.5V., H.
8. Q303 Collector, 33V., H.
9. Q305 Base, 0.8V., H.
10. Q305 Emitter, 4V., H. (Varies with setting of AGC Control)
11. Q307 Base, 2.2V., H.
12. Q307 Collector, 5.4V., H.
13. Q304 Base, 0.8V., H.
14. IC800 Pin 1, 1.8V., H.
15. IC800 Pin 2, 0.65V., H.
16. IC800 Pin 7, 1.2V., V.
17. IC800 Pin 14, 5V., V.
18. Q800 Base, 0.65V., H.
19. Q102 Base, 62V., H.
20. B+ ripple, 25V supply, 0.4V., V.
21. D102 and C107 Junction 76V., V.
23. Q400 Base, 2V., H.
24. Q400 Collector, 25V., H.
25. Q401 Base, 8V., H.
26. Q401 Collector, 25V., H.
27. IC400 Pin 2, 2.3V., 3.58 MHz
28. IC400 Pin 3, 1.8V., 3.58 MHz
29. IC401 Pin 6, 1.3V., w/CM, IC401 Pin 6, 1.2V., w/o CM, 3.58 MHz
30. IC401 Pin 7, 0.9V., w/CM, IC401 Pin 7, 1.2V., w/o CM, 3.58 MHz
31. IC400 Pin 4, 3.6V., H.
32. IC400 Pin 6, 1V., 3.58 MHz
33. IC400 Pin 7, 1.2V., 3.58 MHz
34. IC400 Pin 8, 1.3V, 3.58 MHz
35. IC400 Pin 13, 0.2V., H.
36. IC401 Pin 11, 6V., H.
37. IC401 Pin 10, 5V., H.
38. IC401 Pin 9, 2V., H.
39. IC401 Pin 3, 0.55V., H.
40. TP400, 1.4V., H.
40A. Q403 Collector, 0.4V., H.
41. Q700 Base, 10V., H.
42. Delay line output, 1.7V., H.
43. Q704 Base, 2.3V., H.
44. Q705 Base, 11V., H.
45. Q705 Emitter, 11V., H.
46. Q706 Base, 2V., H.
47. Q707 Base, 4V., H.
48. Q708 Base, 6V., H.



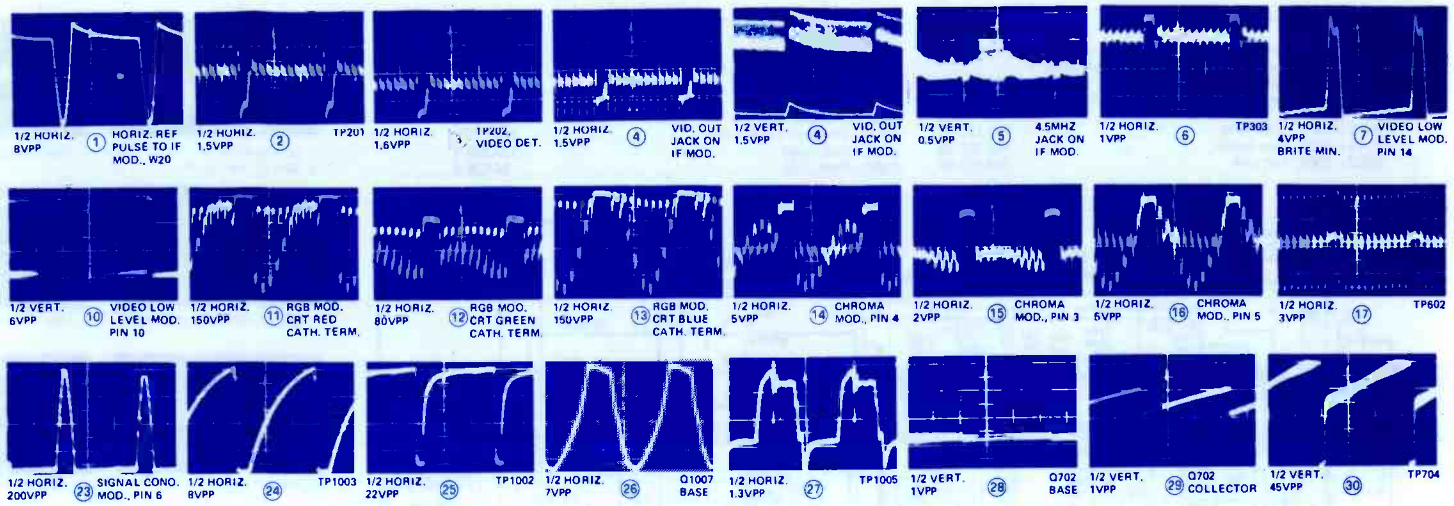
49. Q706 Collector, 130V., H. w/CM
Q706 Collector, 90V., H. w/o CM
(Drive control at maximum)
50. Q707 Collector, 150V., H. w/CM
Q707 Collector, 100V., H., w/o CM
(Drive control at maximum)
51. Q708 Collector, 150V., H. w/CM
Q708 Collector, 100V., H., w/o CM
(Drive control at maximum)
52. Q600 Emitter, 0.65V., V.
53. Q601 Collector, 60V., V.
53A. P703 Pin 1, 42V., V.
54. Q100 and Q101 Emitter, 42V., V.
55. Q101 Collector, 1.75V., V.
56. C122 Positive Terminal, 250V., V.
57. C122 Negative Terminal, 600V., V.
58. P703 Pin 2, 230V., H.
59. IC800 Pin 4, 1V., V.
60. IC801 Pin 3, 6.5V., H.

VHF TUNER
94A502-1 & 94A503-1

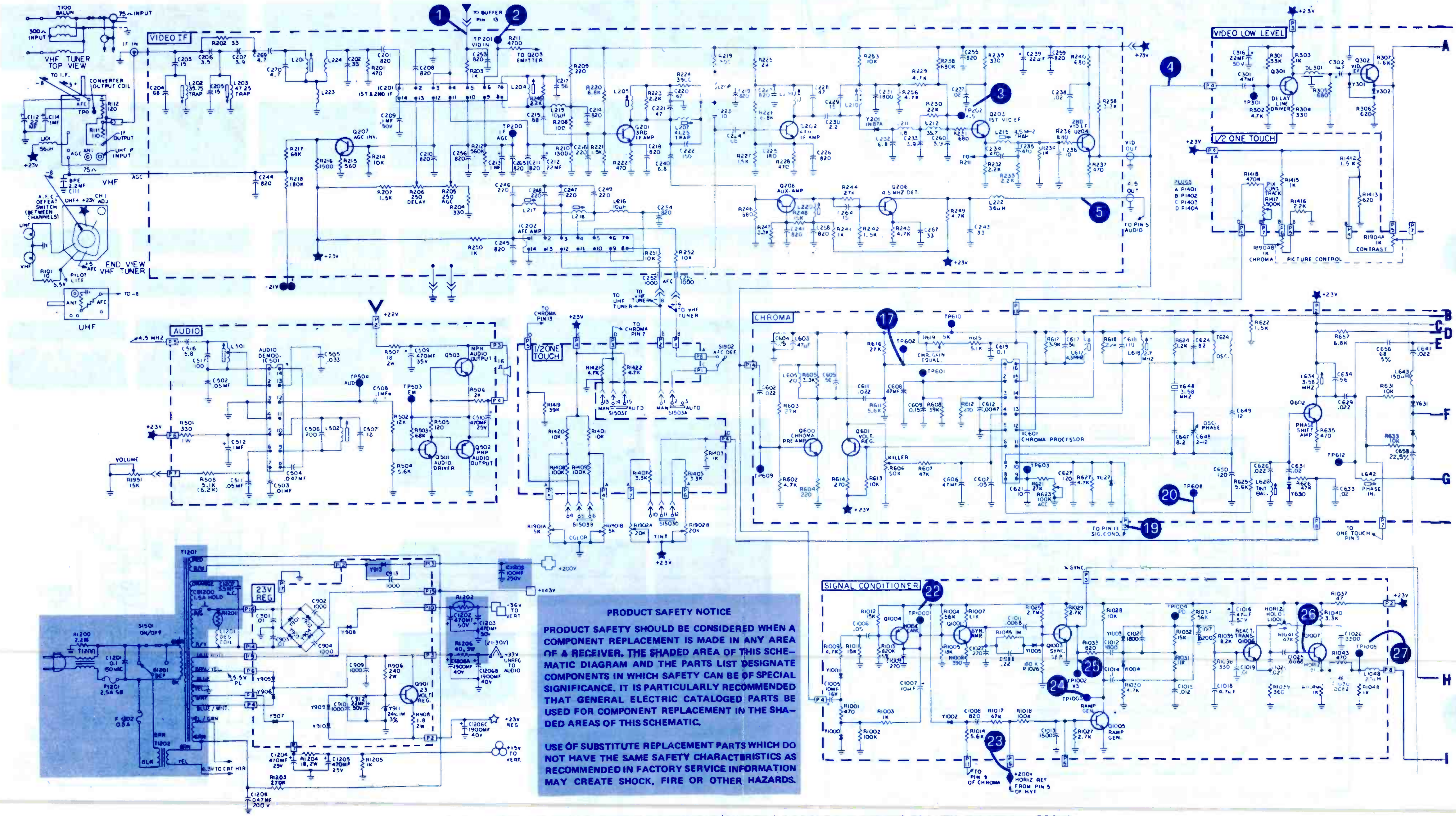


1575 GENERAL ELECTRIC
Color TV Chassis 25MC

ELECTRONIC TECHNICIAN/DEALER TEKFAX
MARCH • 1975
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS



SYMBOL DESCRIPTION	GENERAL ELECTRIC PART NO.
R1663—focus resist	EP14X84
R205—1F AGC, 250Ω	EP49X142
R325—sharpness, 500Ω	EP49X140
R340—brite limit, 10K	EP49X140
R413—red drive, 9 K	
R433—green drive, 9K	EP49X141
R453—blue drive, 9K	EP49X141
R606—killer adj, 50K	EU49X35
R619—chroma gain equal, 5K	ES49X627
R623—ACC adj, 100K	EP49X143
R706—vert size, 3.5M	EP49X144
R709—vert center, 2K	
R1113—horiz center, 150Ω	EP49X147
R1662—focus pot, 18M	EP62X59
C1206A, B,C—1900μf, +100—10%, 40v	EP31X42
C1702A, B—400μf, +100—10%, 175v	EP31X58
DL301—delay line	EP36X105
L501—audio take off	EP36X106
L502—quad	EP36X107
L626—coil, tint bal adj	EP36X112
L634—phase, 3.58MHz	EP36X112
L642—chroma phase	EP36X112
L1001·horiz osc hold	EP35X2
L1613—width coil assmy	EP36X151
L1702—filter reactor	EP63X10
T624—3.58MHz osc	EP36X113
T1201—power xformer	EP62X54
T1700—high voltage xformer	EP77X24
Q1701—horiz output, NPN	EP15X45
Q1702—HV reg, NPN	EP15X29
circuit breaker 1.5a, CB1201	ES10X18
fuse 2.5a 125v, slo blo, F1201	EP10X13
fuse .5a, 250v, fast blo F1202	ES10X43
Quadrupler HV HVM 1601	EP62X57
tuner VHF solid state	EP86X38
yoke deflect	EP76X10

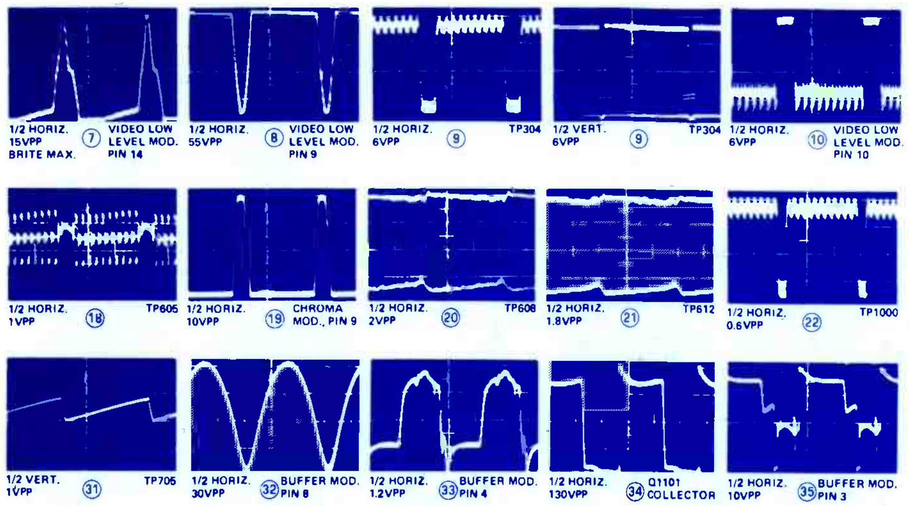


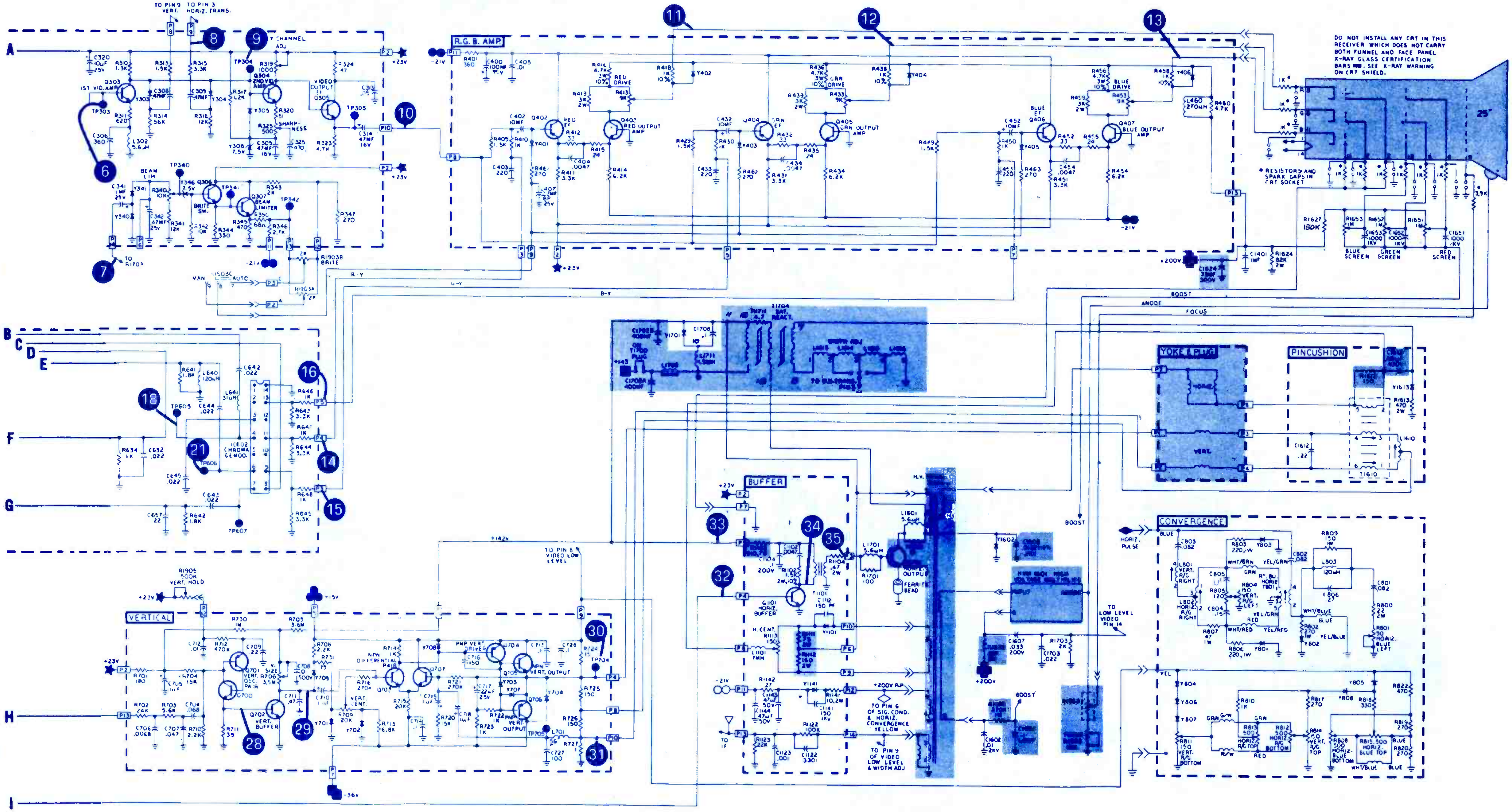
PRODUCT SAFETY NOTICE

PRODUCT SAFETY SHOULD BE CONSIDERED WHEN A COMPONENT REPLACEMENT IS MADE IN ANY AREA OF A RECEIVER. THE SHADED AREA OF THIS SCHEMATIC DIAGRAM AND THE PARTS LIST DESIGNATE COMPONENTS IN WHICH SAFETY CAN BE OF SPECIAL SIGNIFICANCE. IT IS PARTICULARLY RECOMMENDED THAT GENERAL ELECTRIC CATALOGED PARTS BE USED FOR COMPONENT REPLACEMENT IN THE SHADED AREAS OF THIS SCHEMATIC.

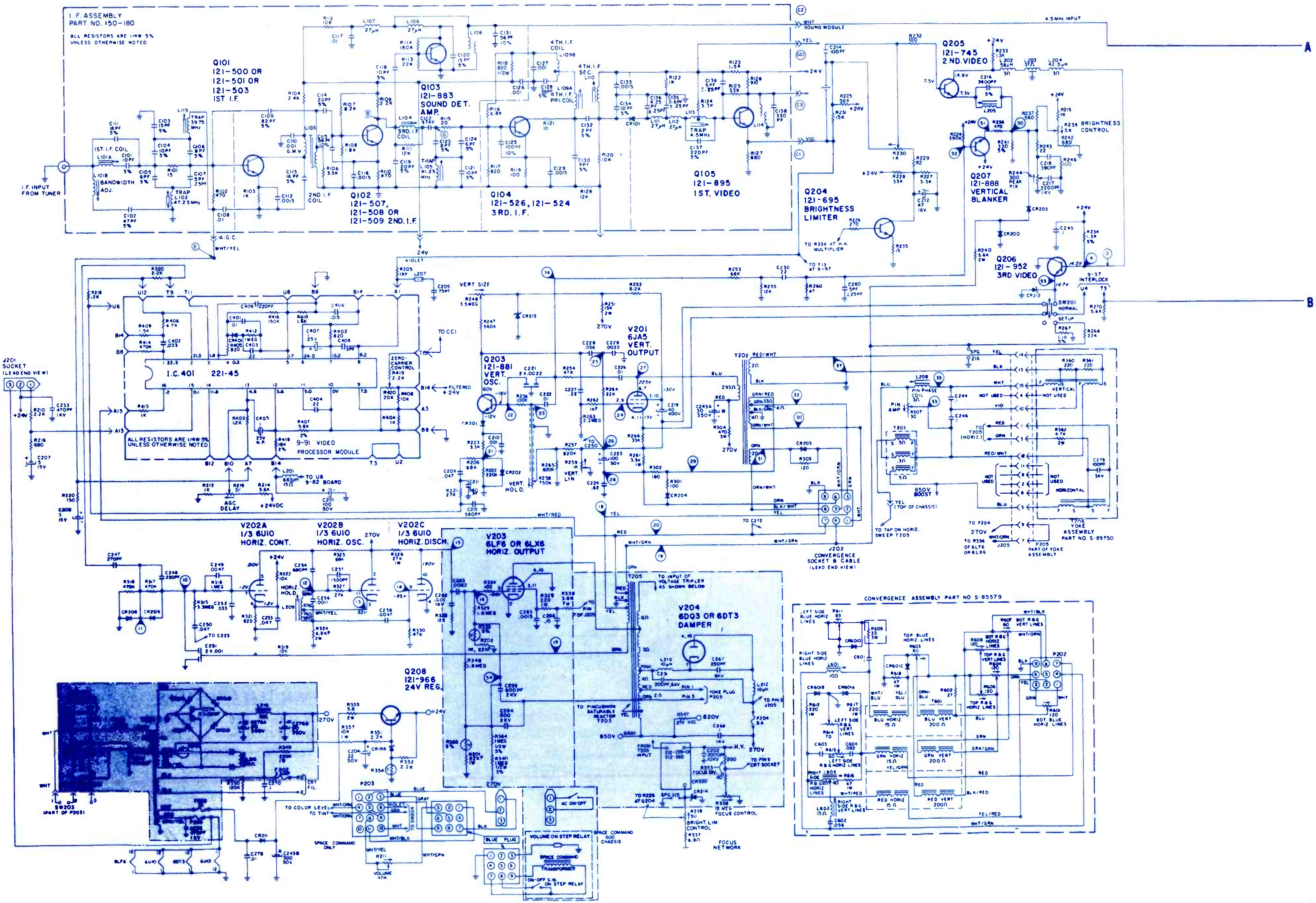
USE OF SUBSTITUTE REPLACEMENT PARTS WHICH DO NOT HAVE THE SAME SAFETY CHARACTERISTICS AS RECOMMENDED IN FACTORY SERVICE INFORMATION MAY CREATE SHOCK, FIRE OR OTHER HAZARDS.

GENERAL ELECTRIC
Color TV Chassis
25MC

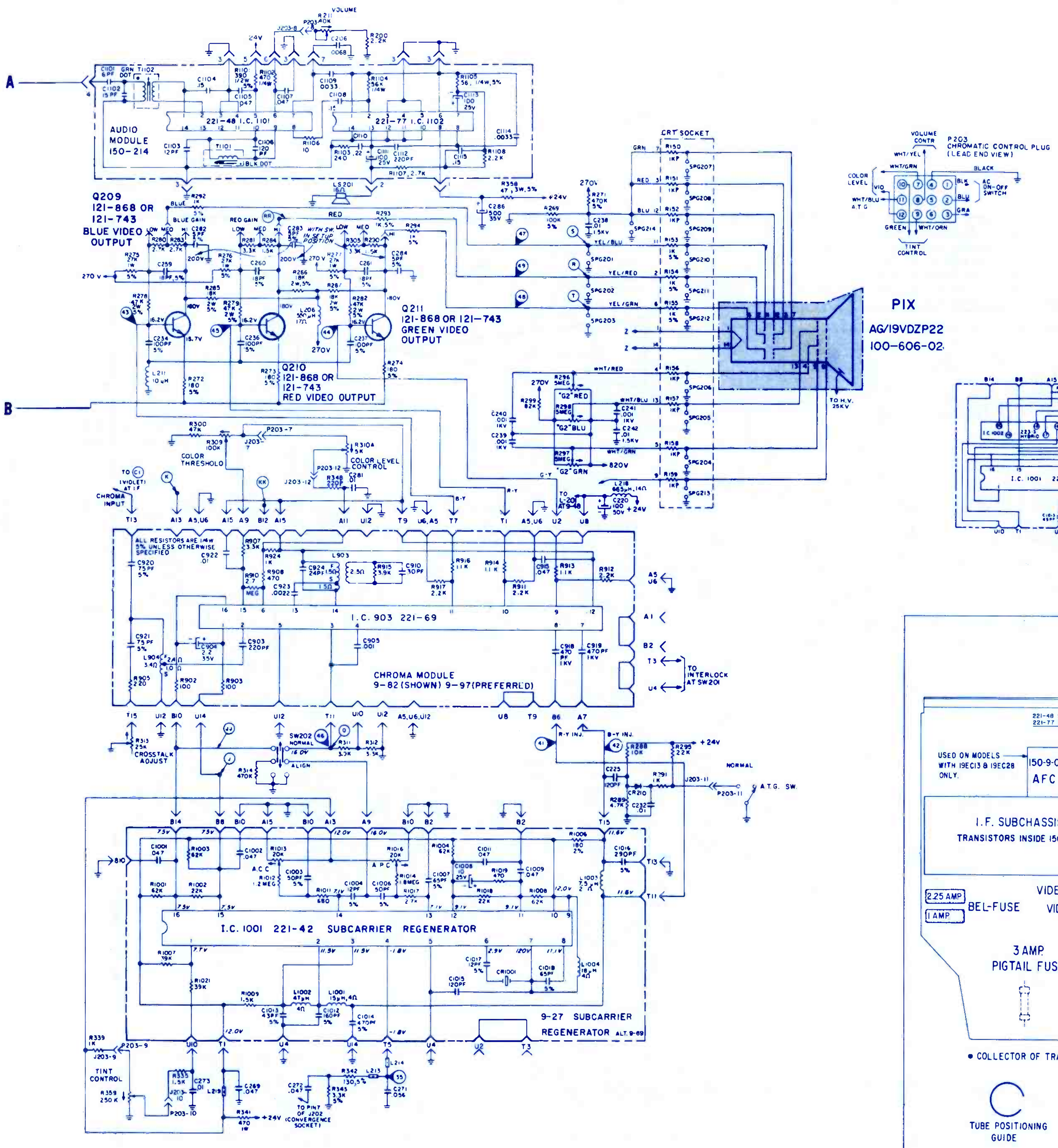




ELECTRONIC TECHNICIAN/DEALER TEKFAX
MARCH • 1975
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS



ZENITH
Color TV Chassis
19EC22



NOTE: SPG204 THRU SPG213 AND R150 THRU R159 IN CRT SOCKET.

NOTES

TURN POWER OFF BEFORE REPLACING SEMICONDUCTORS.

PHOTOGRAPHS TAKEN ON A STANDARD GATED RAINBOW COLOR BAR SIGNAL. HUE SETTING ADJUSTED FOR PROPER COLOR. THE WAVESHAPES AT THE RED, GREEN AND BLUE CATHODE GRIDS OF THE PICTURE TUBE DEPEND ON THE HUE, COLOR LEVEL, CONTRAST AND PICTURE PEAKING CONTROLS.

FOR WAVEFORMS 43 THRU 49, TEST POINT "D" MUST BE BY-PASSED WITH A 1MFD. CAPACITOR.

ALL VOLTAGES MEASURED FROM CHASSIS TO POINTS INDICATED.

ALL VOLTAGES ARE D.C. UNLESS OTHERWISE SPECIFIED.

ALL D.C. VOLTAGES TO BE MEASURED WITH A VACUUM TUBE VOLTMETER WITH INPUT IMPEDANCE OF 11 MEGOHMS.

ALL VOLTAGE MEASUREMENTS TO BE MADE WITH NO SIGNAL PRESENT AND NORMAL SETTING OF CONTROLS. CHANNEL SELECTOR SET TO CHANNEL TWO, UNLESS OTHERWISE SPECIFIED.

RESISTANCE MEASUREMENTS SHOWN WITH ADJACENT COILS DISCONNECTED FROM CIRCUIT.

ALL RESISTORS ARE ± 10%, CARBON, 1/2 WATT UNLESS OTHERWISE NOTED.

COIL RESISTANCE UNDER ONE OHM NOT GIVEN.

ALL CAPACITOR VALUES IN MICROFARADS UNLESS OTHERWISE NOTED. FOR TOLERANCE, SEE LEGEND.

CATHODE RAY TUBE 2ND ANODE VOLTAGE TO BE MEASURED WITH ELECTROSTATIC OR 20K OHM/VOLT (MINIMUM) HIGH VOLTAGE METER.

ARROWS ON POTENTIOMETERS INDICATE CLOCKWISE ROTATION.

PF = PICOFARADS   MHz = MEGAHERTZ   μH = MICROHENRY

ALIGNMENT AND TEST POINT;   CHASSIS GROUND;

VOLTAGE SOURCE;   ± 20% MAY BE USED;

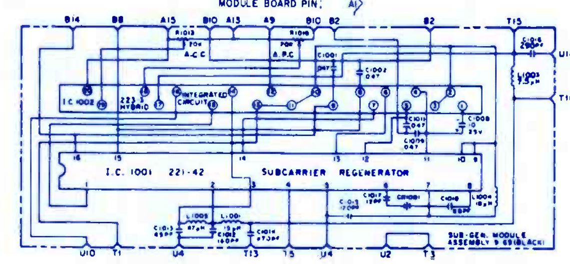
WAVEFORM CHECK POINT; MEASURED FROM POINT INDICATED TO CHASSIS GROUND.

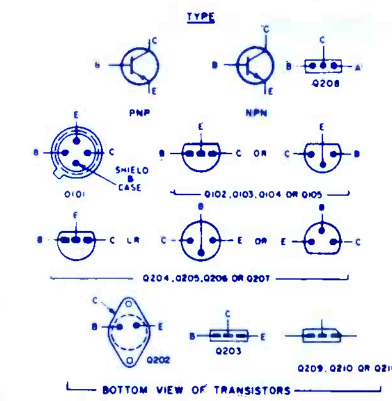
WAVEFORM CHECK POINT; MEASURED ACROSS POINTS INDICATED (NOT TO CHASSIS GROUND). OCILLOSCOPE SHOULD NOT BE GROUNDED TO CHASSIS, REVERSING LEADS REVERSES WAVEFORM.

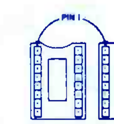
CHROMATIC SWITCH WIRING POSITION;

MODULE BOARD;

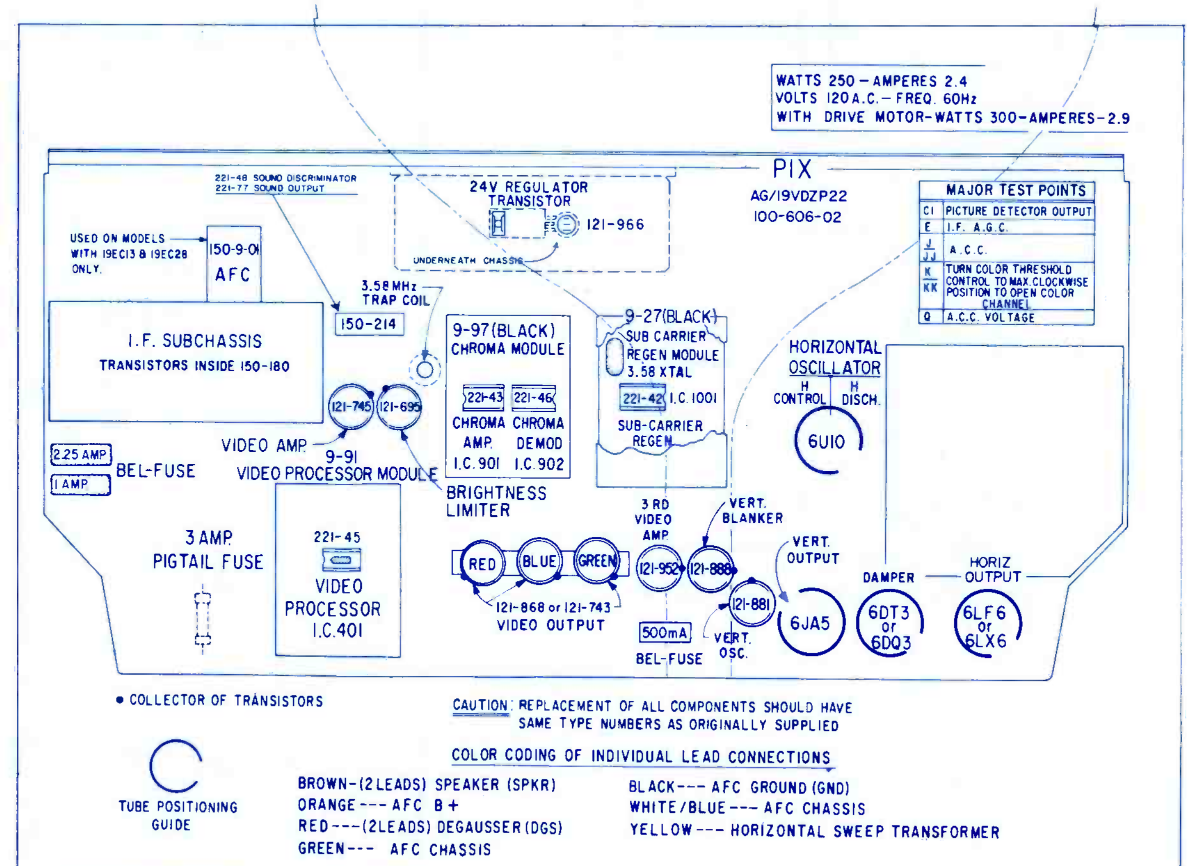
MODULE BOARD PIN;







TEST POINTS	
B	BY-PASS WITH 470PF DURING 4TH I.F. ALIGNMENT.
C1	PICTURE DETECTOR OUTPUT
CC1	BIAS POINT FOR C1 ADJUST
C2	SOUND DETECTOR OUTPUT
C3	SYNC DETECTOR OUTPUT
D	BY-PASS WITH 25μF 25V ELECTROLYTIC DURING COLOR ALIGNMENT
E	I.F. A.G.C.
G	INPUT TEST POINT FOR 4TH ALIGNMENT
J / JJ	A.C.C.
K / KK	TURN COLOR THRESHOLD CONTROL TO MAX. CLOCKWISE POSITION TO OPEN COLOR CHANNEL
SND	SOUND OUTPUT
Q	A.C.C. VOLTAGE
R	RED COLOR AMP. COLLECTOR
S	BLUE COLOR AMP COLLECTOR
T	GREEN COLOR AMP COLLECTOR
R / RR	BRIGHTNESS LIMITER SET-UP POINTS



CAUTION: REPLACEMENT OF ALL COMPONENTS SHOULD HAVE SAME TYPE NUMBERS AS ORIGINALLY SUPPLIED

COLOR CODING OF INDIVIDUAL LEAD CONNECTIONS

BROWN—(2 LEADS) SPEAKER (SPKR)
ORANGE— AFC B+
RED—(2 LEADS) DEGAUSSER (DGS)
GREEN— AFC CHASSIS
BLACK— AFC GROUND (GND)
WHITE/BLUE— AFC CHASSIS
YELLOW— HORIZONTAL SWEEP TRANSFORMER

1577

TRAV-LER

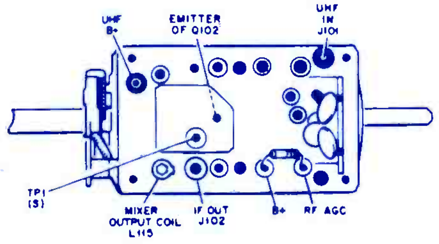
TV Chassis
TL6/TIL6

ELECTRONIC TECHNICIAN/DEALER TEKFAX

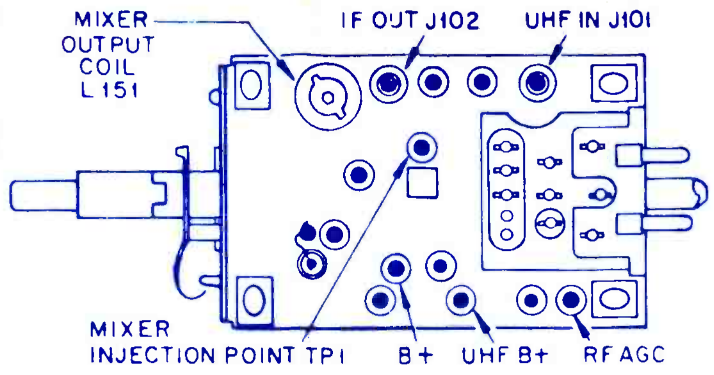
MARCH • 1975

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS

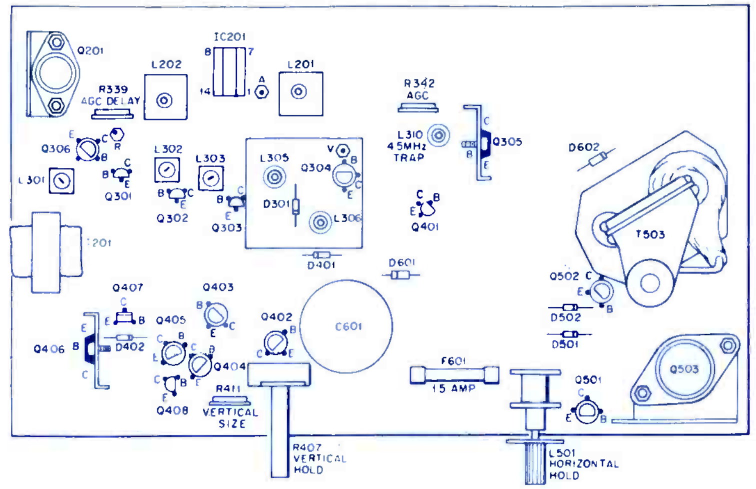
SYMBOL	DESCRIPTION	TRAV-LER PART NO.
C603	250/200/150 μf, 165v electro	67A30-11
L201	coil 4.5MHz	72A317-1
L302	coil 1st video 1F	72A415-1
L303	coil 2nd video 1F	72A415-1
L310	coil 4.5MHz trap	72A317-9
L501	coil horiz lock	94A480-1
T201	xformer audio output	79A172-1
T401	yoke deflect TL6-1A-2A	94A372-3
T401	yoke deflect T1L6-1A-2A	94A372-4
T502	xformer horiz output	79A166-3
R203	25K volume control	75A1-210
R326	500Ω, contrast control	75A1-211
R333	100K, brite control	75A1-212
R339	400Ω, AGC delay	75A101-35
R342	400Ω, AGC control	75A101-35
R411	2M, vert size	75A101-61
R407	1.2M vert hold	75A191-3
	fuse, 1.5a	84A7-5



Top View of VHF Tuner (94A434-2) Showing Test Point and Alignment Locations

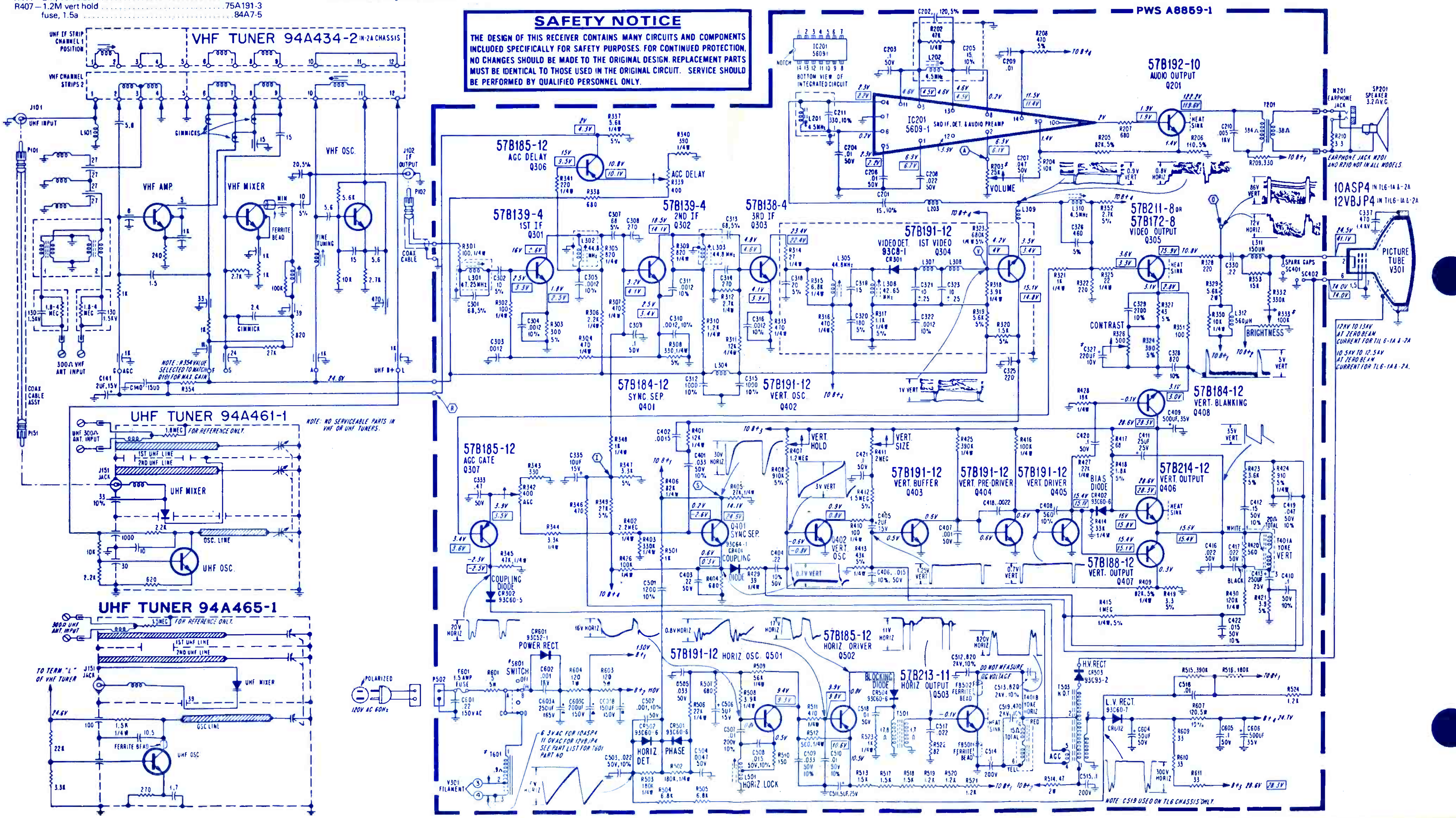


Top View of VHF Tuner (94A433-2) Showing Test Point and Alignment Locations



SAFETY NOTICE

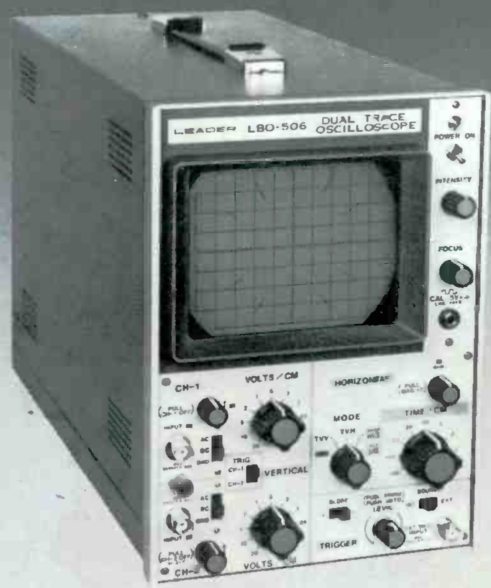
THE DESIGN OF THIS RECEIVER CONTAINS MANY CIRCUITS AND COMPONENTS INCLUDED SPECIFICALLY FOR SAFETY PURPOSES. FOR CONTINUED PROTECTION, NO CHANGES SHOULD BE MADE TO THE ORIGINAL DESIGN. REPLACEMENT PARTS MUST BE IDENTICAL TO THOSE USED IN THE ORIGINAL CIRCUIT. SERVICE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY.



LEADER

Automatic

Dual Channel/Dual Trace 5" Scope/Vectorscope



- **Automatic** Trigger
- **Automatic** Horizontal Sweep
- **Automatic** Vertical Input

Automatic operation is the key and virtually error free accuracy is your bonus with this unique 5" Dual Trace Scope. The advanced design even lets you read between the ranges in any position, as easily as you can with analog VTVM's or VOM's. High reliability PC boards assure long term dependability while a high intensity CRT delivers excellent contrast. It features: separate or simultaneous sweep display, Ch 1 & 2 - alternate, chopped, auto/norm trigger; 10MHz b'width; 10mVp-p/cm to 20Vp-p/cm vert'l sensitivity in 11 calib. steps; 0.5μS/cm to 0.2S/cm sweep range, 18 steps calib.; X5 mag.; XY and vectorscope displays. Compact, lightweight, economical.

$569.95

MODEL LBO-506

Complete with probes, terminal adapters, test leads.

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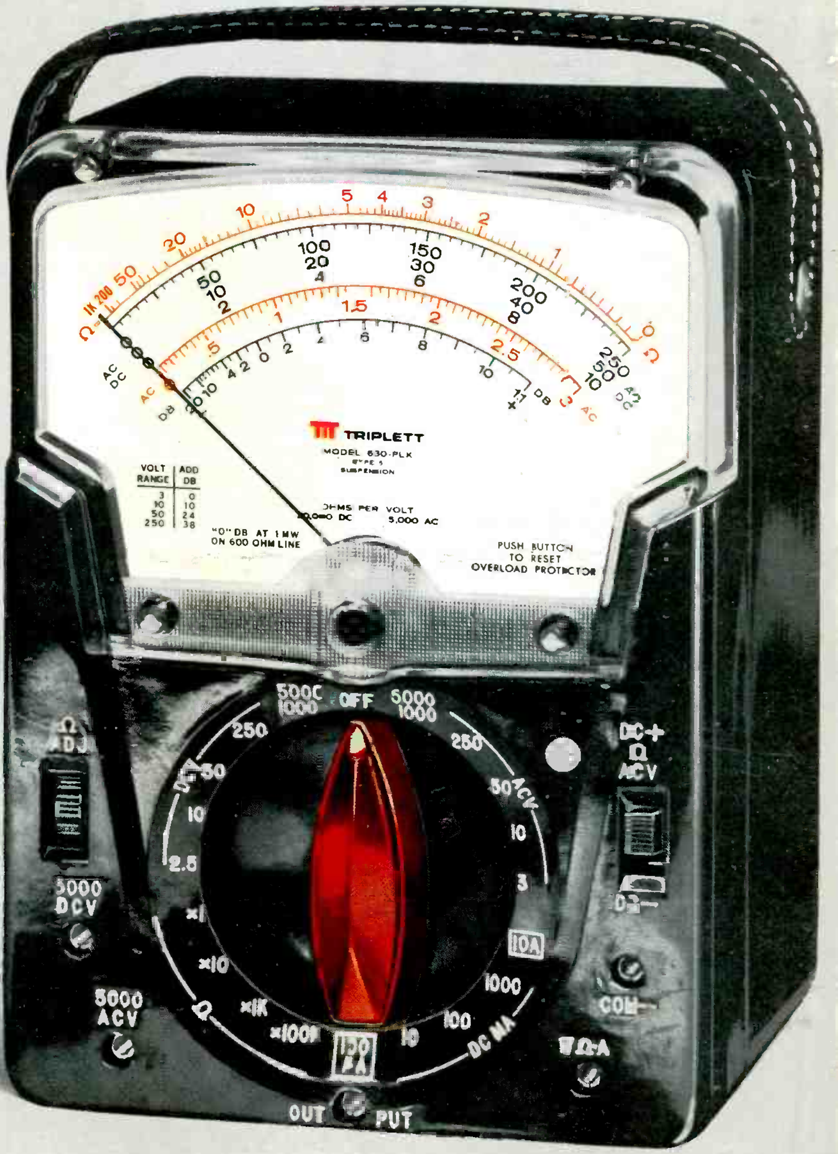
Instruments Corp. 151 Dupont St., Plainview, L.I., N.Y. 11803 **(516) 822-9300**

...for more details circle 119 on Reader Service Card

Our 630-PLK won't die of shock.



The Model 630-PLK V-O-M is priced at just $125.

Does everything you'd expect of a high-quality general purpose V-O-M. An exclusive, patented, transistorized switching circuit gives the Triplett Model 630-PLK virtually fail-proof protection against overloads. That makes it very popular with teachers and students, and with professionals where constant switching invites overload errors.

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3. **4 ohmmeter ranges with a 4.4 ohms center scale.**

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For more information or a free demonstration, call your Triplett distributor or sales representative. For the name of the representative nearest you, dial toll free (800) 645-9200. New York State, call collect (516) 294-0990. Triplett Corpora Bluffton, Ohio 45817.

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