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Electronic Servicing

Formerly PF Reporter

Updated Source Guide to Imported Sets, page 38

Plus practical servicing info about vertical sync, audio in auto radio, TV alignment and auto stereo FM multiplex.

"Take the problems off the customers' back...

. . . Give service, not arguments. And give it on time—a definite, pre-scheduled time when the customer can expect the set to be returned. Don't let parts become a major problem—it is a problem only to the extent you let it become one. Know your costs and establish your service prices accordingly. Warranty and service contracts can be profitable, and customers like them." Tony D'Angelo, general manager, Central Service Co., Chicago. See article: Page 10.


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What are your hours?
I'm interested in everything about you when I look you up in the Yellow Pages.
Yellow Pages

November, 1969 • Volume 19, No. 11

Electronic Servicing

Formerly PF Reporter

in this issue...

DEPARTMENTS

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Circle 3 on literature card

electronic scanner

news of the industry

NEA Outlines Serviceability Project

The National Electronic Associations (NEA) is embarked on a program to improve the serviceability of consumer electronic equipment. The program is based on a two-way exchange of servicing information and suggestions between servicers and manufacturers. The goal of the program is to reduce the time needed to service sets.

Improved serviceability of consumer products should be of continuing concern to both manufacturers and service technicians. In past years such continuing concern has not been voiced by a majority of either segment of the consumer electronic industry. The term serviceability was heard only sporadically, and even then only in connection with consumer-directed propaganda designed to amaze rather than educate consumers about the real meaning and benefits of improved serviceability.

NEA is conducting a continuing nationwide serviceability survey among its member shops. The servicemen point out problems which they feel could be easily corrected in manufacturing with little expense or effort. The results of the surveys periodically are sent to the manufacturers involved, including the servicers' suggestions for improvements in design, service information, parts procurement and safety. Serviceability Guidelines have also been drawn up and sent to the manufacturers, outlining ways for more efficient means of servicing and better consumer-relation techniques.

NEA has begun a program of "in-plant" serviceability consultations with manufacturers, which are expected to occur semiannually. Products are inspected on the line, and details of service information and parts supply are discussed. Such consultations usually involve one or more of NEA's independent service technicians. Any manufacturer may schedule consultations.

Periodically, a committee of six to twelve technicians evaluate the serviceability of products in the field, and their findings are submitted to the manufacturer of the set.

One more facet of the project is soon to be added by NEA. As suggested at the recent Eastern Service Conference in Philadelphia by representatives of the manufacturers, blank "Techni-Tip" forms will be supplied to national service managers of set-makers. The forms are prepared so that field changes and service "fixes" can be listed. NEA will distribute these to its members and, soon, to nonmember service shops.

Hitachi Provides 5-Year Warranty of Solid-State Components

An extended warranty that provides five-year coverage of solid-state components is now in effect on all Hitachi color TV receivers currently being marketed by Hitachi Sales Corporation of America.

The new warranty program was announced recently by Morton M. Schwartz, Marketing Director of Hitachi Sales Corporation, who explained that "all solid-state

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WATCH FOR NEW CENTERS UNDER DEVELOPMENT

Circle 5 on literature card

components are guaranteed for five years, the picture tube and all other parts are covered for two years, and labor costs are free for one year on a carry-in basis to any of the Hitachi service stations nationwide."

Two factors have made the warranty extensions possible, according to Schwartz: "First, Hitachi manufactures all the components that go into our sets and second, our labs in Japan have recently completed accelerated 'test-to-destruct' studies that condense years of continuous transistor use into a much shorter period of time. The results of these tests confirmed the practicality of extending the warranty."

Seasonal Farm Workers To Be Trained As TV Technicians

Seasonal farm workers in North Carolina will be retrained for jobs in the electronic industry, including television repair.

The Choanoke Area Development Association (CADA), an anti-poverty agency in North Carolina involved in retraining seasonal farm workers for jobs in industry, has set up a pilot program to teach television repair to men who have been displaced on farm operations.

CADA will initiate the project with two training sessions daily in a mobile Automated Training Center (ATC) developed by RCA. The agency will select trainees from Bertie, Halifax, Hertford and Northhampton counties of North Carolina.

The mobile ATC unit is a 10′ x 45′ house trailer that accommodates eight students per class and includes a specially designed self-study curriculum, student tests and laboratory materials, tools, test equipment, television receivers, reference library and electronic trainers designed specifically to fit the curriculum.

Color TV Servicing Booklet Available From EIA

Information on buying, installing and servicing a color television set is provided in a new booklet just published by the Electronic Industries Association (EIA) and the National Better Business Bureau.

Entitled "Color TV—What You Should Know About Purchase, Installation, Service," the booklet contains hints on conditions that could affect the quality of picture reception, factors that determine charges for a service call, and what to expect from a service call.

Single copies of the booklet are available without charge from the EIA Service Committee, 2001 Eye Street, N.W., Washington, D.C. 20006. Quantity orders (at 3 cents per copy) should be sent to the National Better Business Bureau, 320 Park Avenue, New York, N.Y. 10017.

Mitsubishi Begins Marketing of Color TV in U.S.

Mitsubishi Electric Corporation, Japanese manufacturer of TV and housewares, has begun exporting color TV receivers to the U.S. market, according to a recent report in **Home Furnishings Daily.** Initial shipments will include 13- and 15-inch color sets that will be marketed under both Mitsubishi and private label brand names. Sales will be handled by Mitsubishi International Corp. ▲

letters to the editor

Association President Speaks Out on Licensing

Your July issue of ELECTRONIC SERVICING contained much worthwhile food for thought, especially in the article dealing with technician licensing and in the letters to the editor by Mervin Collier, Louis Montoya and Jon Wiswell.

Other than saying that Mr. Collier's conclusions are particularly well stated, I will confine my comments to some opinions expressed by Mr. Montoya. Mr. Montoya's concern about any form of business regulation by government is shared, to some degree, by most people in the electronics servicing industry. Unfortunately, though, our world outside of Flat Rock, N. C., is not the fairy tale that Mr. Montoya believes it to be. Besides the many competent technicians who may or may not have a "natural talent for repair," there exists in our profession a few, but noisy, individuals whose natural talents lie in other directions.

False and misleading advertising, deceit, butchery and incompetence do, unfortunately, exist and, unfortunately again, not everyone has the desire to abide by ethical standards or accent the inherent responsibilities of professionalism.

A technician (as opposed to a "repairman") is responsible for much more than merely replacing a part and presenting a bill. His responsibilities extend to the complete unit he is servicing, to the customer who owns it, the public in general, himself, his family, his fellow professionals and his profession as a whole.

The licensing of technicians and dealers is not a cure-all (and can even be a nightmare when drafted and imposed by outside agencies); but it is a partial expression of concern by the dealer for the consumer. It imposes upon ALL in an area SOME of the ethical requirements already accepted by the majority.

Licensing in any area will NOT put a TECHNICIAN out of a job (it might create obstacles for a few "repairmen") and it SHOULD not create an unjustifiable tax burden.

As stated in the article, there are many pros and cons; but it appears that very few knowledgeable persons are opposed to the intent of a good licensing law.

Mr. Collier and Mr. Montoya both state the obvious need to educate the public. It's less obvious but equally true that many electronics "repairmen" could use a little education, too.

Many of the more responsible and concerned electronics technicians and dealers in Virginia are joining with our association in promoting a proposed licensing act for the profession in this state. Any person in our state who is unaware or unconvinced that this bill is in the best interests of the consumer and the technician or dealer is invited to contact our Director of Consumer Affairs or our president at P. O. Box 13001, Chesapeake, Virginia.

W. S. Harrison
President
Virginia Electronics Association

More on Warranties

I think Mr. W. S. Harrison ("Letters to the Editor" December, 1968) is confused. He accuses the manufacturer of lying. Certainly any reputable company will fulfill its obligation to the customer. Further, the manufacturer has to include an average charge to take care of standing behind the warranty, this is a kind of insurance.

There is no reason why any independent serviceman should perform any type of warranty service without an agreement with the manufacturer, or the customer. When he implies that the serviceman has to charge extra for the packing and return of defective parts without an agreement, he is clouding the issue.

I cannot see why any manufacturer would make an extended guarantee and, at the same time, be secretly plotting the obsolesence of the unit.

Mr. Harrison seems to be advocating shortening the guarantee, building a cheaper unit (it wouldn't have to be so dependable) and letting us independent servicers get a crack at the customers' dollars.

Mr. Harrison should take a look at the auto industry and see how many independent garages have folded up since the extended guarantee on autos has been in effect.

Mr. Harrison says give the customer freedom to choose a "licensed" servicer. How about choosing an unlicensed servicer? Where is the freedom of choice then?

Jack Watt
Ontonagon, MI 49953

▲

New Service Literature

TV TECH AID, Edward G. Gorman, Kings Park, L.I., New York 11754; printed monthly; yearly subscription $7.95.

A monthly summary of actual color TV trouble symptoms, their possible causes and the cure for each. Where needed, a schematic of the circuitry involved is included.

The troubles and cures are grouped according to manufacturer which, in turn, are listed alphabetically. The format of the publication is designed to facilitate filing the troubles and cures according to manufacturer and chassis number—a definite aid to quicker servicing.

Circle 10 on literature card

Service Contracts Sustain

Some Important Elements of Contracting Discussed: The Volume Enjoyed from Distributors and Big Retailers; Contracts Attractive to Customers; Adopting Customer's Viewpoint; Sense of Urgency about Parts; 'Nuisance' Calls.

Central Service, a Chicago firm that began as a 1-man operation more than 20 years ago, now does over $1 million in electronic servicing business annually—most of it based on contracts.[2]

The founder of the firm, Carl Korn[1], believes the reason that contract servicing has not been adopted by more servicing agencies was that the service technician "didn't know how to apportion his income."

"The customers like service contracts," Korn says.

"We got in with some dealers and some big department stores who were selling TV. We were considered the experts. We were getting $90 on a one-year contract on Dumont, for instance. But, in those days, we had to make six or seven service calls a year on a set," Korn relates.

This meant that, although the payment of a contract might be made to his firm when it was sold, it could not all be considered as income at once. The receipts are put in a reserve account when the contract is sold. "On a 12-month contract, we pick up only 1/12th of it every month, or when service is rendered," Korn explains.

Many shops that attempted service contracts disliked and discontinued the program because they failed to establish a sufficient reserve, Korn said. They considered receipts from the contracts as income earned, and were later unable to meet operating expenses. Incidence of service was high in those days, he stresses.

Eighty percent of Central Service income is based on contracts to fulfill warranty service for distributors and retailers.

Before this warranty expires, the consumer is solicited by Central for a year's service contract. They are

[1]Korn is also president of the Dynascan Corp., manufacturers of B & K test equipment. Dynascan was an outgrowth of Korn's experience in the servicing business.

[2]Actually, Central Service does in excess of $2 million in service business annually. About half of it is in air conditioning. The air conditioning business is directed by the same management, and much of the field service is done by the same technicians. Shop facilities are under the same roof, but distinctly departmentaliezd.

'We have sales meetings, sales contests, technical meetings, all kinds of meetings'

Carl Korn, founder of the firm, talks about customers: "We seek to understand the customer's point of view. We ask ourselves, 'What is it that the customer really wants?' We do that instead of taking the serviceman's point of view, 'What can we get out of this?' It's an entirely different concept.

"We take the problems away from the customer and put them on our own back. This is exactly what a service company is supposed to do. This is what we're in business for.

"We lean over backwards to understand the customer's problem. The customer calls because he has a complaint. We rectify the problem with performance, not argument. If you argue with a customer, you never hear from him again.

"Do the work for nothing to satisfy a complaint."

"First of all, we have to recognize we're not perfect. We must resolve: 'We're never going to get into an argument with a customer. We must keep the customer. We prefer to lose one charge rather than to lose the customer . . .' " [He refers here to the demand customer. The same attitude prevails in dealing with the contract customer.]

The general manager of Central Service, Chicago, Tony D'Angelo, talks about the parts problem: "If you push hard enough for a part, and you really work to get it, you'll get it."

The girl who works this "shop control" post schedules the sets to be repaired in the order in which they come into the shop. She is also able to tell a customer at any time the progress of the work on a product.

High-Volume Business

solicited by the technicians or through a mail campaign. Technicians also try to convert the "occasional" customer into a contract customer. The price of the service contract is the same regardless of the age of the product, provided a technician inspects it and it is accepted.

Central does not have a telephone sales program to sell contracts, such as Sears and RCA have, but Korn says he believes it is a good program, and would like to develop it.

When a consumer covered by warranty is solicited for a contract, he is offered the same coverage he has under the warranty. If the warranty provides that the customer carry in the product for service, he is offered a carry-in contract. If he had in-the-home service, he is offered an in-the-home contract.

A $94.95 contract on a TV set covers all parts and labor—unlimited service, everything. Another contract is sold for $49.95 per year. It includes all parts and a preferred labor rate—$7.95 per service call. This service call covers all service—in-the-home service, pick-up and delivery, shop work—whatever is required.

In the original sale of a service contract, the customer is told he will never be refused a renewal of a contract on a product, and there will be no increase in price.

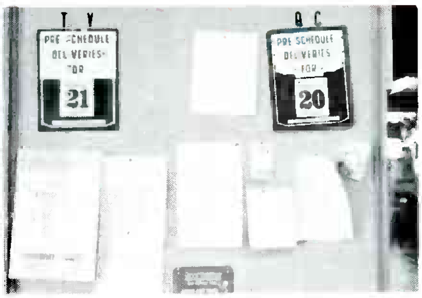
Most of the warranty work is performed under a pre-paid contract agreement. Some retailers and distributors, however, have Central perform the work on a flat-rate basis for service rendered, and the warrantor is billed by Central after the service is performed.

The warranty business comes from distributors and Chicago's Marshall Fields, K-Mart, Goldblatt's and other high-volume retailers.

The warrantor sets it up on a 30-day, 90-day or 1-year basis. Other provisions of the warranty vary, depending on what the distributor warrants and what the dealer wants to offer his customer.

For example, the distributor may sell a set with a 90-day warranty, but the dealer may want to offer a year's warranty. So, he supplements it. Central Service tailors the contract to the individual dealer's needs. Terms of the contracts, therefore, vary considerably between dealers.

The parts department manager, Frank Kappel, is seen here waiting on a customer. His job also includes a lot of management duties. He heads a department of 12, and is responsible for the purchase, inventory control and distribution of parts within the organization. The owner of the firm praises the "sense of urgency" that prevails in the parts department.



Pre-Scheduled Deliveries at Central Service means that a definite date for return of the product is scheduled before the technician removes it from the home. Delivery is made as scheduled in 95% of the cases. The dates displayed here are notice to the technicians of the date (usually four working days hence) when they should promise return for sets picked up that day. They, in turn, notify the customer of the date they will return the product. It is a firm commitment. For example, before the technician takes a TV chassis from the home, he fixes a notice to the cabinet stating the date the chassis will be returned and requesting the set owner to please be home at that time. The pre-scheduling of return of the product has a beneficial effect in two or three ways, Korn explained. Among other things, it cuts down on the number of telephone calls from customers asking about the progress of the repair, and when it will be returned. The pre-scheduling also acts as a stimulant to good management. "We put our internal organization here to administering to make sure we get the set back to the customer when we said we would. The sets that are not delivered are those (5%) with rare parts that we just can't get hold of. Basically, we put the problem on us instead of on the customer. We have eliminated the customer's concern that we'll come with the set when she is gone. With our pre-scheduling, she has a definite appointment for return of the set."

"How do you know what to establish as a price for the contract?"

The answer to that question is "knowing what your costs are."

Training and Incentives

The technicians receive incentives for production and commissions for selling service contracts. The incentive for production is part of the agreement under the union contract with the technicians. He receives no commission or incentive for selling parts and labor—not even for service done for customers not under contract. Demand service is done on a flat-rate basis. "One of the prime reasons we went to flat-rate was so the customer knows in advance how much we are going to charge," says Tony D'Angelo, manager of Central Service.

D'Angelo believes this company has a perfect set-up for training apprentices.

"We have a few people who came to us knowing nothing about television. They came to our organization, showed some drive, some aptitude, and are now doing a good job in TV servicing outside." The average time required to train the new man to a point where he could be called a "qualified" service technician is about one year. For some, it takes less, for others, more time, D'Angelo says.

Company managers and technicians do a lot of the training. They also ask manufacturers and distributors to give training courses, which is the greater part of the training program.

If a technician desires training in a course aside from that provided by the company, Central will pay for it. But such training is not required, nor even urged by the company.

Normally, training sessions are held twice weekly, but if the work load is very heavy, the training schedule is interrupted.

Apprentices begin by waiting on customers at the counter, testing tubes, dusting the chassis, connecting leads, chasing parts, changing parts after diagnosis or doing the mechanical work of assembly or disassembly.

Highest Level People —Highest Level Work

Use of apprentices for more routine tasks permits the more skilled men to produce more, Korn explained. "Our theory is: The highest level people do the highest level work." The shop is called a diagnostic center. The "highest level people" are the journeymen, the diagnosticians.

"This is the theory, and I say the theory works fine. However, a lot of times it is faster for the technician to go ahead and do it himself, instead of looking for the helper."

"The basic idea was to give the guys the tools and make them stay in one place, and have them be able to fix sets as quickly as possible. The journeyman can call a helper to go to the parts department for him and, in some cases, to actually replace the defective part if it is going to involve an appreciable length of time, so the more experienced technician can go to work on another set," Korn said.

Parts Availability —A Problem?

"The parts problem exists to the extent that the person looking for parts allows it to exist," says Tony D'Angelo, general manager. "I

'Shop is oriented to keep highest level people on highest level work'

Efficiency dramatized. From the moment they walk through the front door until they turn from the long service counter to leave, customers can see that their TV sets are processed systematically through various stages, from original diagnosis until final "air test".

The "air test" is made, on the average, for a couple of days. The sets are placed here after they are repaired and double-checked. (Prices posted on the front of this rack are for "demand" customers, and do not apply to customers covered by warranty or Central's service contracts.)

Tables are used to move the chassis from one station to another. There are enough tables for the technicians to use as many as needed.

mean to emphasize that if you push hard enough for a part and you really work at it, you'll get it. The place where you have some difficulty is with some of these off-brands, because there is no place to go. But, locally, where you have the big manufacturers and distributors, I can't see a parts availability problem." The imported sets are most likely to present parts problems, he said.

Controls can minimize such problems, this manager says. "Sure, there are exceptions. Occasionally they need a part and just can't get hold of it, and someone has to wait a couple of weeks. You have to have controls, a lot of them! For example, each week I get a listing of work that has been in our shop two weeks or more. Then, it's up to me to do something—to go out and get those parts. And, in most cases, they are available. Someone comes up with them."

Sense of Urgency

"We don't play around," says the founder of the firm. "Our parts department has a sense of urgency about it. Customers have been scheduled, and we have to make sure that we meet the schedule. It is not a case of 'We'll do it when we get around to it.' "

The parts manager, Frank Kappel, is responsible for the purchase, inventory control and distribution of parts within the organization.

Parts for both air conditioning and TV are handled by the one department, including 11, sometimes 12 men. This number includes three men who run around all day chasing parts. These men also deliver parts each day to the branch shops.

The parts are inventoried according to manufacturer when practical. Stocks of frequently-needed, inexpensive parts are kept near the work benches. High-value parts are kept in the stockroom.

The Travel Problem

This firm has partially resolved the travel problem and extended its market by establishing two branches. Central Service's headquarters, parts department and main shop are located on Chicago's northwest side. A branch was opened on the south side and another on the west side. The branches are staffed with bench men. The outside men who work out of the branch shops report there each day.

The outside men from each of the shops plan their itinerary when they load their trucks each morning. They do not have 2-way radio, but call in to central headquarters during the day.

There is one shop control for all three branches, and the telephone calls all come into the central office.

Personnel

The business staff at Central Service includes 22 girls who do clerical and secretarial work, a dispatcher, four top managers and two medium managers.

The number of outside technicians varies from 60 to 75. They have the capability of repairing air conditioners as well as electronic products. There are 20 inside technicians who work on TV and other electronic products, and 15 inside men assigned to air conditioning during the summer months.

Air Conditioning Offsets Summer Slump of TV Servicing

The air conditioning service busi-

The Service Bench was designed after many nights of brainstorming by the company managers. Note these features: The color test jig below; the service cart pulled up in front of the service bench (the casters of another cart on the other side of the service bench can be seen); the service bench itself is not mobile—note the legs do not have wheels; however, over the service bench there is attached the test equipment which swivels around on a carrousel. The advantages are many: The technician, without moving either the chassis or the test equipment, can be processing two sets at once. For example, let's say he found the defective part in the chassis on the cart in the foreground in this photo. He sends the apprentice to the parts department to get the part and install it and, without losing any time, the technician himself walks around the octagonal-shaped bench and begins working on the chassis on the cart on the other side. He can swing the test equipment around on the carrousel so that it can be used on any side of the bench, and, he can also turn the service cart around to get at any side of the chassis. With the apprentice technician or helper performing the routine duties of parts chasing, parts replacement and preliminary preparation of each chassis for diagonsis, a larger portion of the skilled technicians' time can be devoted to actual diagnosis procedures and, consequently, he can service more sets per shift. Carl Korn explains the objective behind the shop system: "We want to give the technician the facilities for working on more than one set at a time. He's got a mind, and we want him to use it. We don't want him to be using only his hands."

ness was taken on by this firm to make up for the summer slump in demand for electronic servicing. This is a factor in the success of the GE and RCA factory service centers and some other high-volume service companies.

Customer Communications and Scheduling of Service Calls

"We have lots of communication going on here," says Korn. "We have 25 lines for customer calls. In the morning, when the operator opens the switchboard at 9, invariably 25 lines go off, and everybody in the place is taking phone calls." He gave an example of the volume of telephone calls handled. In the the first four days in one week, there were: 960 calls on Monday, 849 on Tuesday, 786 on Wednesday and 782 on Thursday.

There are a minimum of 8 to 10 girls taking calls at all times during working hours. All of the clerical staff (22 clerks) are trained to take calls, however.

Customers who call before 3 p.m. can usually be promised a service call the next day. The girls are given each day a quota of customers who can be promised next-day service. When that quota is reached, or after 3 p.m., the customer is promised service on the second day, rather than the first day after the call is received. Even if the quota set for the day is not reached, the promise of next-day service must be cut off at 3 p. m. to permit the dispatcher time to make up the routes for the outside men.

The written service orders are passed on to the dispatcher, who also acts as service manager. His is a very critical post in the organization, D'Angelo emphasizes.

When the switchboard is unplugged at the close of each business day and for the weekend, an answering service takes over. So, customer orders can be received 24 hours a day, seven days a week. Two customers can be giving a service order through the answering service at any one time, as the answering service provides two lines.

Although the switchboard closes Saturday noon for the weekend, Saturday is considered the busiest day of the week at Central Service. Both inside and outside men are on the job. Most of the technicians work six days a week, and some evenings. Those who work only five days take off some day other than Saturday. "That is the way we can keep up with the work and offer quick service," D'Angelo says.

All Requests for Service are Fulfilled

D'Angelo explained that the clerks who receive the calls from contract or warranty customers do not attempt to determine whether or not a service call is really needed—all requests are fulfilled.

"Our experience is that if you try to qualify the call [by telephone] as to whether or not it is due to an actual electronic failure, you will aggravate the customer. It just isn't worth the trouble," he said.

Even though it has been found that in a majority of cases there is no electronic failure, the service call is made, without questioning the need for it. In fact, Central Service believes there is a need for the call as long as the customer is dissatisfied with the performance of the product, and Central responds with a service call. What they often find are non-electronic problems, including simple lack of understanding of tuning the set—and other consumer problems that generate "nuisance" calls. Obviously, Central's charge for a contract must be based accordingly, to include the expense of making these types of calls.

Incidence of Calls Per Warranty Contract

The average incidence of service of sets under the 90-day warranty is 1½ service calls per set (for color TV). This is in addition to the service call to make the set-up, which is part of the agreement. In practice, then, Central makes an average of 2½ calls per set under the 90-day warranty that they service for the retailer. ▲

'Nuisance' Calls a Factor

One element that takes some of the gloss off the contract servicing picture, however, is "nuisance" calls. They originate from the tendency of some customers to get all they possibly can out of something they have paid for—making quite a few more service calls for a product under contract than they would make if there were a charge for each service call.

But those who make a contract program work look at a contract service business as they would at an insurance business—it is a matter of averages—the good risks more than compensate for the bad risks.

A Texas service technician, Norris Browne, Houston, says that the unnecessary demands for service under a contract program are indeed a problem. His experience has been that 60 percent of his service calls are in this category. His firm makes an average of 2½ customer calls on a 90-day contract. He has found, however, that service is required on less than half of these calls. Most of his contracts are to cover the warranty for two or three multiple-line dealers.

The observation of a California technician is that "unless a contract is written very tightly, nuisance calls are prohibitive."

Another high-volume servicer who sells a lot of service contracts says that the cost of a contract has to be based on each individual contractor's experience. He suggests the way to establish the cost is to go over old sales lists to determine average calls made under different contracts offered.

Perhaps it is the attitude taken by Carl Korn towards the customer that enabled him and the firm he founded, Central Service, to take in stride the "nuisance" calls that many technicians find to be too burdensome.

Stereo FM Multiplex in Auto Radio -- Theory of Operation

by Forest H. Belt & Associates

An ordinary FM signal, according to FCC regulations, consists of sound frequencies between 50 and 15,000 Hz, frequency- or phase-modulating a station RF signal. It's important to remember that the sound frequencies determine how rapidly the station signal shifts up and down (deviates) in frequency, and that the actual amount of deviation is determined by the strength of the sound signals fed to the FM modulator.

As an example, any full-strength sound signal modulates a monophonic FM station 75 KHz up and 75 KHz down. The chart in Fig. 1A graphs this for you. It's called 100 percent modulation. A half-strength sound signal, representing 50 percent modulation, deviates the transmitter center frequency only 37.5 KHz up and 37.5 KHz down (Fig. 1B).

This amount of deviation has nothing to do with the sound frequency—at least not directly. A full-strength 100-Hz signal can deviate the transmitter just as much as a full-strength 10,000-Hz signal. The difference is in the rate of deviation. If a 100-Hz sound signal is fed to the modulator, the transmitter frequency shifts upward and downward 100 times each second. With a 10,000-Hz sound signal, it shifts (deviates) up and down 10,000 times each second.

However, a factor that affects deviation of the regular FM-station signal is a thing called pre-emphasis. To improve FM transmission, the sound section of an FM transmitter has filter circuits that boost high-frequency parts of the sound or music signals. The filter has a characteristic called a 75-μsec pre-emphasis curve. The receiver, to restore the signal to a normal flat 50-15,000-Hz response, must have a filter with a 75-μsec de-emphasis curve. The de-emphasis filter is between the FM detector and the audio stages.

From "1-2-3-4 Servicing Automobile Stereo," by Forest H. Belt; Copyright © 1969 by Howard W. Sams & Co., Inc., Indianapolis, Indiana.

The Multiplex Signal

Stereophonic FM originates in a studio (or a recording) that has two sound-pickup channels. A microphone (or sound track) to the listener's left feeds the left or L channel; a similar microphone to the listener's right picks up sound for the right or R channel.

If the L and R channels are mixed together in phase, the result is about the same as if a single microphone or sound track were used. The result is called L + R. If the L and R sound signals are fed together to an FM transmitter, they frequency-modulate the station carrier (center frequency) just as any single-channel sound signal would. The station output is a monophonic program. Ordinary FM receivers pick up L + R broadcasts the same as they would any monophonic FM transmission.

For stereo-FM receivers to reproduce the L and the R channels separately, a lot more has to be done to the signal at the FM station. First of all, besides being combined as L + R, the separate L and R signals are fed into a subtracting mixer. The R signal is fed to this stage 180 degrees out of phase with the L signal. The result is known as the L − R signal. The L − R signal can't be modulated directly on the station center frequency, because it would mess up the L + R signal. Instead, a system called multiplexing is used.

The L − R signal is amplitude-modulated on a special subcarrier. For standard stereo FM, the subcarrier is 38 KHz. The AM process creates sidebands, as you probably know; sidebands are "beat" frequencies above and below the carrier frequency. So, the L − R sound signals, beating with the 38-KHz subcarrier, make sidebands above and below 38 MHz.

FCC Rules say the subcarrier must be virtually eliminated. What's

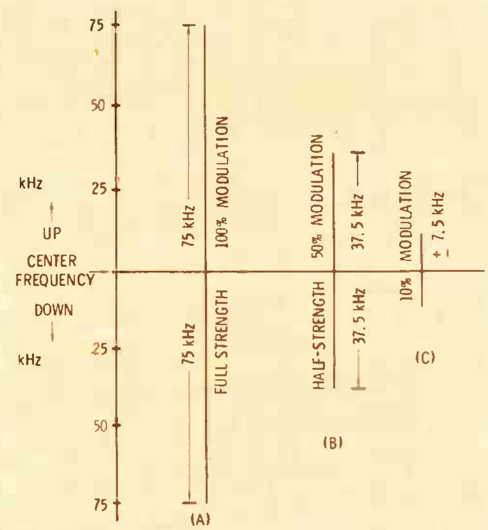


Fig. 1 Graph of modulation percentages for an FM signal.

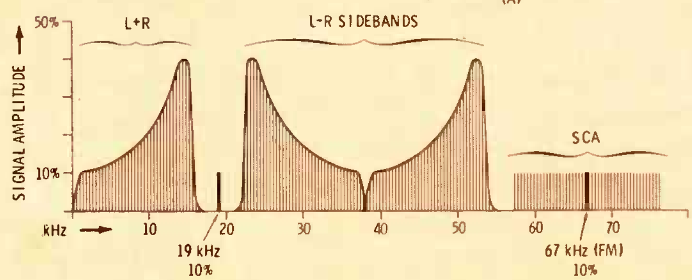


Fig. 2 Frequency spectrum of signals applied to modulator in FM transmitter.

left is a set of sidebands above and below 38 KHz. If the sound signals that originally produce the L – R signal extend all the way to 15,000 Hz, the sidebands could reach as far down at 23 KHz and as far up as 53 KHz.

The diagram of Fig. 2 shows a graph of the frequency spectrum between 0 and 75 KHz. The curves show what frequencies in that spectrum are fed to the modulator in a stereo-FM transmitter. The single-frequency signal at 19 KHz is a pilot signal. It goes to the receiver to synchronize a 38-KHz reinsertion oscillator or amplifier stage in the multiplex section. (The 38-KHz subcarrier must be added to the sidebands before the original L – R sound signals can be recovered.)

The curves in Fig. 2 represent signal strengths at different points in the 0-75-KHz spectrum. They slope because of the pre-emphasis filters that affect L and R signals in the studio before they are added (L + R) or subtracted (L – R). Because of the pre-emphasis curve, sounds above 1,000 Hz are boosted. Thus, if you have 5,000-Hz and 500-Hz sounds of equal loudness, they reach the mixers and modulators at different levels. The curves don't mean all the frequencies are necessarily present at any given instant, or in the strengths shown. In fact, that never happens. The curves in Fig. 2 merely show the signal levels at the various frequencies between 50 and 75,000 Hz if all possible frequencies were present in the studio. The signals that actually do occur depend on what the two widely spaced studio microphones pick up originally.

Notice, too, that the curves go up to only 40 percent on the signal-amplitude scale. FCC regulations permit no more than 100 percent modulation. So, even for stereo, the total level of signals fed to the modulator can't be more than just enough to drive the center frequency 75 KHz up and down. The pilot signal at 19 KHz is set to produce 10 percent of total modulation; the L + R, which is modulated directly, only modulates 40 percent of maximum at full volume; the L – R sidebands aren't allowed to exceed 40 percent; and the SCA (storecasting) signal—if it's used—is injected at 10 percent level. (During normal broadcasts, the L – R sidebands stay well below the 40 percent level, and SCA injection can be made somewhat higher—just so total modulation doesn't exceed 100 percent or ±75 KHz.)

Block Diagram Functional Analysis

Fig. 3 shows the block diagrams of several versions of stereo-FM multiplex auto receivers. Note the similarity.

An example of a simple multiplex section is drawn in Fig. 4. This one is in a Delco stereo-FM receiver. The stages listed are typical of many home stereo receivers, too. Following is a description of the main purpose of each stage:

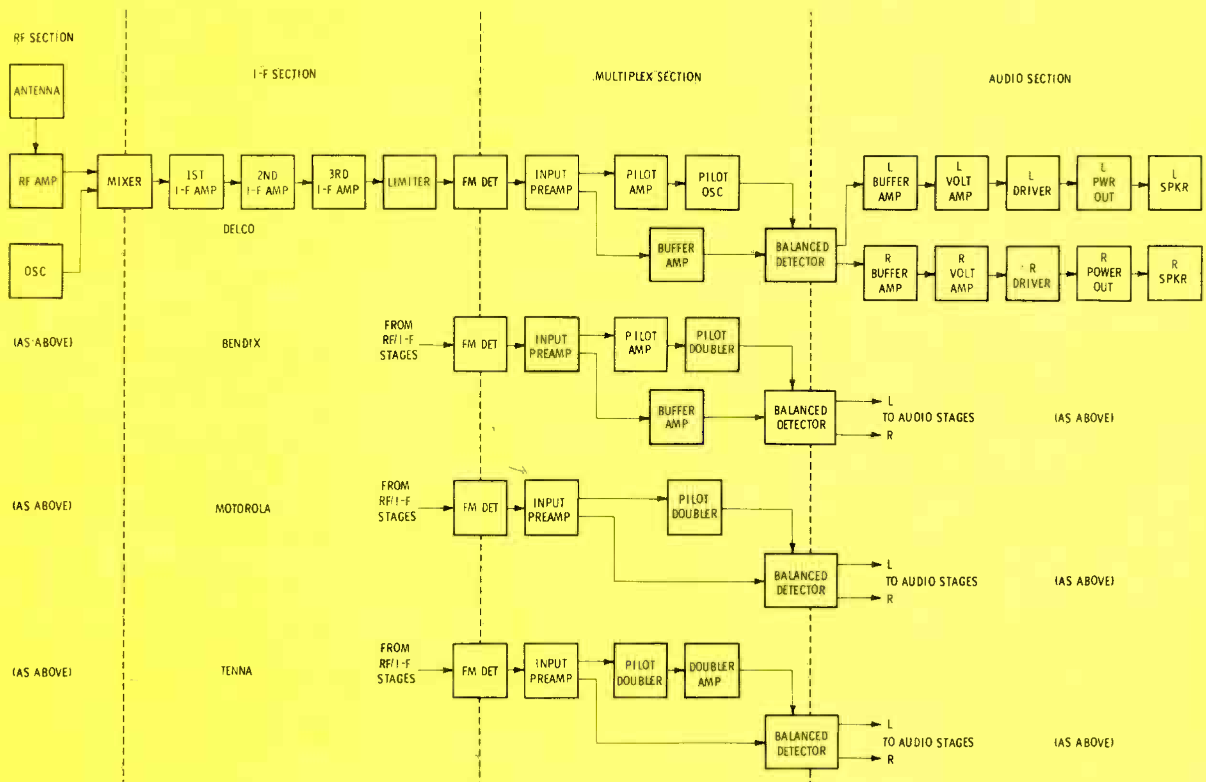


Fig. 3 Block diagrams of four different models of stereo FM auto radio, grouped by sections and subdivided into stages.

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Balanced Detector

This stage recovers the left and right sound signals. To do that, it has functions that rely on the signals fed to it.

First is recovery of L – R from the sidebands. Amplitude demodulation is necessary, since the information was put on the subcarrier by AM. But amplitude demodulation (AM detection) requires a carrier. A duplicate of the original 38-KHz subcarrier must be re-inserted.

A 38-KHz signal from the pilot oscillator mixes with the L – R sidebands from the buffer amplifier. Demodulation occurs. So there's a recovered L – R signal in the balanced demodulator. The now useless sidebands and any leftover 38-KHz signal are eliminated.

The second function of a balanced detector is to mix the L – R with the L + R signal. The L + R is demodulated directly by the FM detector in the receiver. It comes to the balanced detector by way of the input preamplifier and the buffer amplifier. The two signals—L – R and L + R—come together in a special way. On one side of the detector, they're added together; on the other, they're subtracted.

Looking at the two signals algebraically:

Adding:

$(L - R) + (L + R) =$

Removing parentheses:

$L - R + L + R =$

Combining terms:

2L (on the add side)

(The R's cancel.)

Subtracting:

$(L - R) - (L + R) =$

Removing parentheses:

$L - R - L - R =$

Combining terms:

–2R (on the subtract side)

(The L's cancel.)

So, the output of the balanced detector is a left-channel audio signal from one side and a right-channel audio signal from the other. That the right-channel signal is inverted (the minus sign) is not important. The left (L) signal is fed to its audio amplifying string, and the right (R) signal goes to its audio amplifying string.

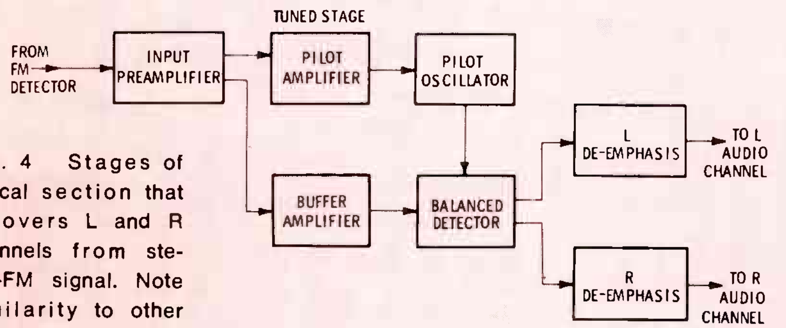

Fig. 4 Stages of typical section that recovers L and R channels from stereo-FM signal. Note similarity to other multiplex sections shown in Fig. 3.

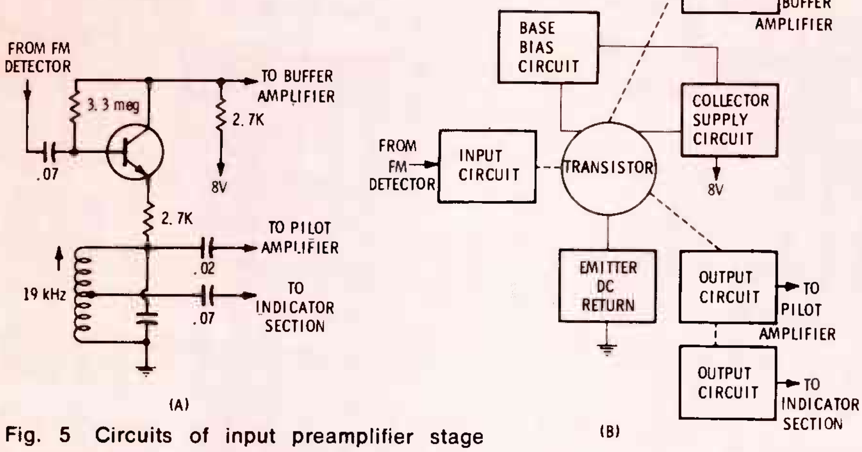

Fig. 5 Circuits of input preamplifier stage in Delco receiver multiplex section. A) Schematic diagram. B) Block diagram of individual circuits.

Pilot Oscillator

This is where the signal comes from to mix with the L – R sidebands in the detector, so L – R can be recovered. In the unit we're using as an example, the 38-KHz pilot oscillator is controlled by a 19-KHz signal coming from the pilot amplifier.

The 19-KHz pilot signal from the FM transmitter is precisely in step with the 38-KHz subcarrier that produced the original L – R sidebands. If the signal fed to the receiver pilot oscillator is strong enough, the pilot signal holds the phase of the 38-KHz reinsertion carrier precisely in step. If it didn't, the L – R sidebands wouldn't release an accurate version of the original L – R signals.

Pilot Amplifier

This stage serves two purposes, actually. You've already read about one. The receiver's FM detector recovers a 19-KHz pilot signal along with the L – R sidebands and the L + R signals. The pilot signal is stereo sync. It synchronizes the subcarrier that mixes with the L – R sidebands in the balanced detector. For dependable control, the pilot signal must be stronger than the receiver detector can make it. That's one job of the pilot amplifier.

You'll notice the pilot amplifier is a tuned stage. It's sharply tuned to 19 KHz. That means it prevents frequencies above and below from passing—its second purpose. There can be no false triggering of the pilot oscillator by strong signals at some other frequency. Only the exact-phase 19-KHz control signal reaches the oscillator.

Buffer Amplifier

Its name suggests the purpose of this simple stage. It isolates the high impedance of the balanced detector from the low impedance of the input preamplifier. That this stage isn't absolutely essential is proved by the fact that many other stereo-FM receivers omit them. (If you want to glance back at Fig. 3 again, you can see that the Tenna and Motorola sets don't have this stage.)

Input Preamplifier

This stage goes by various names, but it is included in every multiplex section we've examined. Sometimes it is merely an impedance-matching amplifier—an emitter follower, with no voltage gain. It keeps the low-impedance pilot and buffer amplifiers from loading down the FM detector stage of the receiver.

In some units, the two outputs from the input preamplifier are taken separately—one from the emitter and the other from the collector. The result is to keep the 19-KHz path completely isolated from the path of the L — R sidebands and the L + R signals. Tuned circuits in the pilot amplified and filter circutis in the buffer amplifier might interact.

Circuit Analysis of Individual Stages

Input Preamplifiers

The stage in Fig. 5 is the input preamplifier from a Delco stereo receiver. A similar one is used in Bendix and some other brands. The stage is presented two ways. The first is a schematic, as you'd find the stage diagramed in service literature. The second, in Fig. 5B, is a symbolic view that names the circuits in the stage.

The input circuit in Fig. 5 has only one obvious part. If you can isolate the trouble to that circuit, you have probably pinpointed the part. Unfortunately, not all circuits are so simple.

The base takes its bias from the collector circuit, and again only one part seems to be involved. However, as you can see in Fig. 5A, collector voltage comes through a supply circuit from the 8-volt source. If the collector supply circuit became faulty in some way, base bias would be affected. This kind of dependency is something to watch for when you're isolating a faulty circuit. Wrong base bias, in this arrangement, could mean either bad base supply circuit or bad collector supply circuit.

You may be confused by the output circuit. Actually, there are three. One comes off the collector and goes to the buffer amplifier. The other two are in the emitter circuit. A tuned circuit singles out the 19-KHz pilot signal and eliminates the L + R signals and L – R sidebands. The pilot signal is coupled out to the pilot amplifier to be boosted and fed to the pilot oscillator. The third output circuit is from a tap on the tuned-circuit coil. It feeds some of the 19-KHz signal to the indicator section, to turn on a light when stereo is being received.

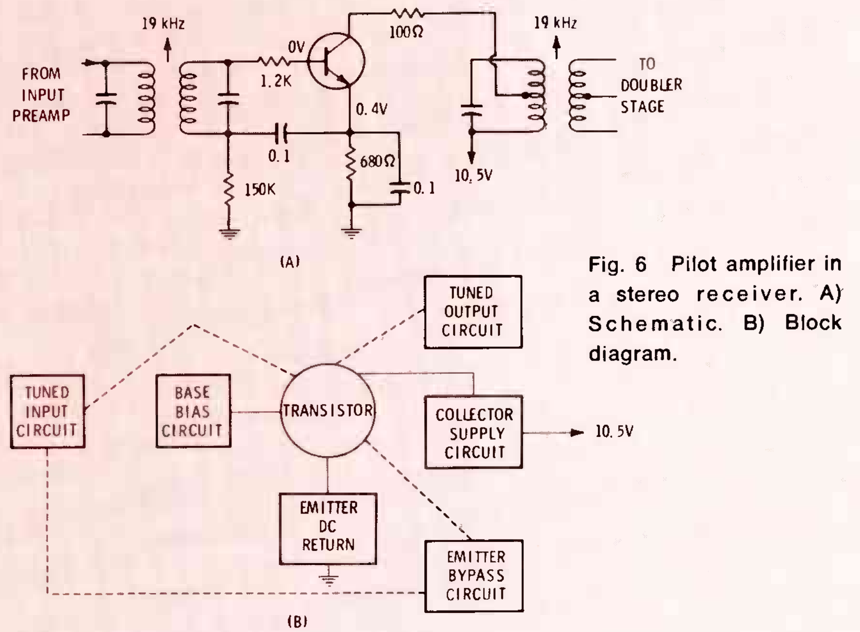

Fig. 6 Pilot amplifier in a stereo receiver. A) Schematic. B) Block diagram.

Pilot Amplifier

The pilot amplifier is such a simple, ordinary transistor amplifier, it's hardly worth going into detail about. A typical one is diagramed in Fig. 6. Both presentations should help you recognize the names of the circuits. This particular pilot-amplifier stage is in a Bendix stereo receiver.

The tuned transformer is the input circuit. The dashed line in Fig. 6B means it's a signal circuit. It might also be part of the DC supply circuit—and it is—but that has nothing to do with your seeing it as an input circuit. When you're evaluating DC circuits in the stage, you of course consider the secondary winding, too, since it's part of the base DC circuit.

The collector circuit also has a double-duty part—the tuned transformer. It is the output circuit, and you think of it that way when you're tracing signals (see the dashed line in Fig. 6B). Yet, when you are analyzing DC circuits in the stage, the primary of that same transformer is part of the collector DC supply (solid line in Fig. 6B).

In the emitter circuit, the resistor

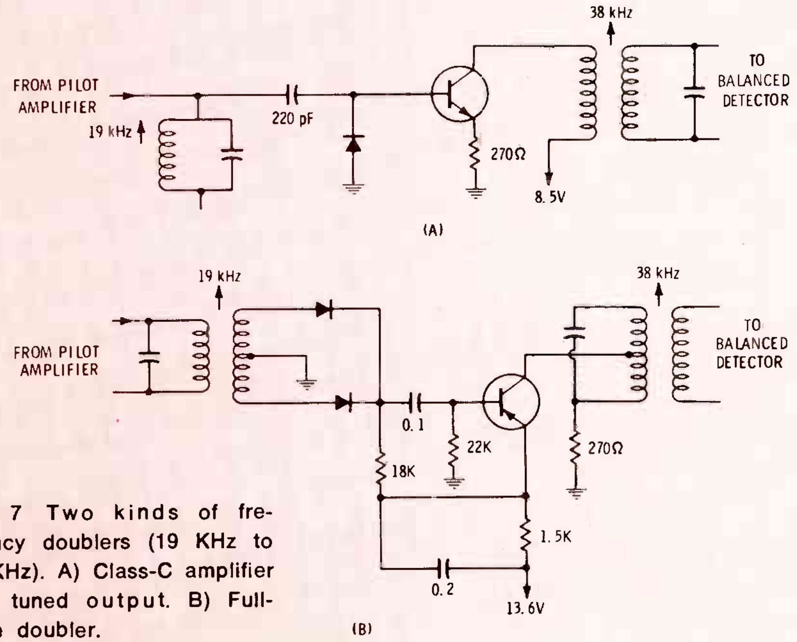

Fig. 7 Two kinds of frequency doublers (19 KHz to 38 KHz). A) Class-C amplifier with tuned output. B) Full-wave doubler.

is the DC return circuit (solid line) and the capacitor is a signal bypass circuit (dashed line). Also notice the dashed line from the tuned input circuit to the emitter bypass circuit. If you've examined the schematic in Fig. 6A, you know that the dashed line represents a signal path through a decoupling capacitor connected from the bottom of the tuned circuit to the emitter bypass circuit. The extra dashed line means you must think about dependency between the two signal circuits. It's important when you're troubleshooting them.

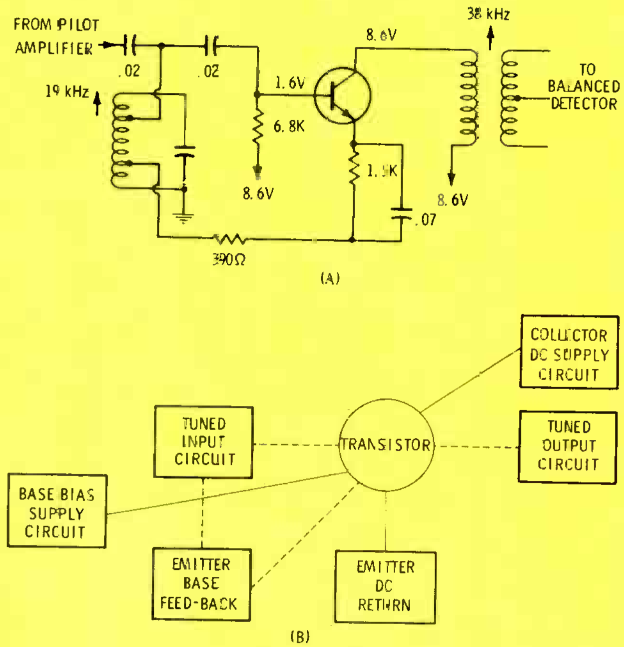

Fig. 8 Pilot oscillator in a stereo receiver. A) Schematic. B) Block diagram.

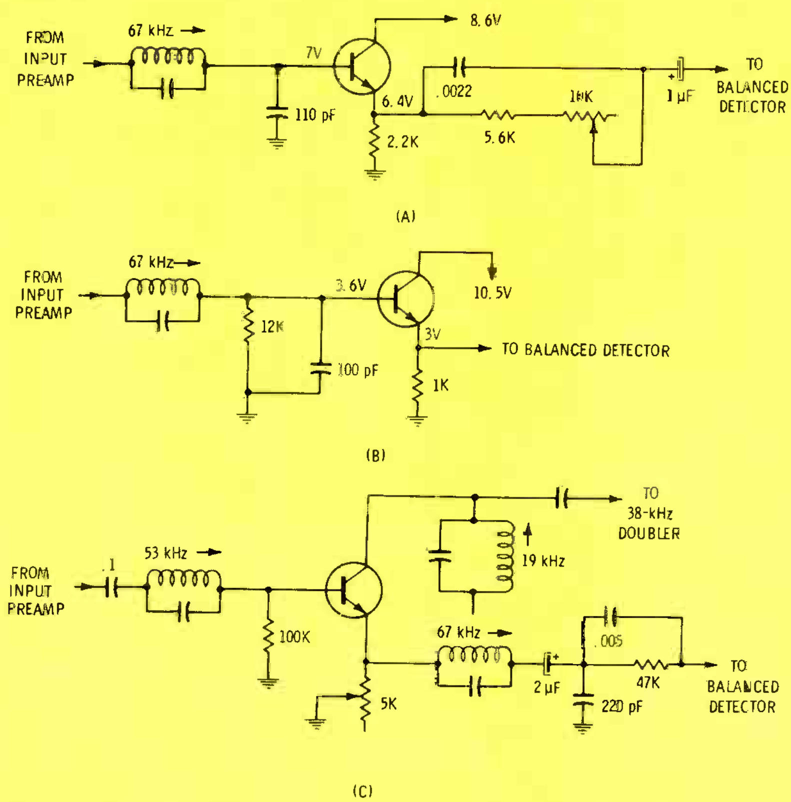

Fig. 9 Buffer amplifiers employed to isolate phase-shift networks. A) With adjustable phase network. B) Without adjustable phase network. C) With adjustable phase network.

Pilot Doubler

There are two kinds of doubler stages. One is a class-C amplifier, with input tuned to 19 KHz and output tuned to 38 KHz. An example, from a Motorola multiplex section, is diagramed in Fig. 7A.

The other uses a full-wave diode stage to raise the 19-KHz signal to 38 KHz. An amplifier then boosts the signal level enough to drive the balanced detector. The diagram of this arrangement in a Bendix set is shown in Fig. 7B. The input circuit is the tuned transformer. The output circuit is the combination of an 18K load resistor and a 0.1-mfd coupling capacitor.

The amplifier stage is routine. The 0.1-mfd capacitor is a coupling component between the output circuit of the doubler stage and the input circuit of the amplifier. The emitter circuit has both DC and signal branches: the resistor and capacitor, respectively. The 38-KHz transformer is the output circuit for signals, and its primary winding is part of the collector DC return.

Pilot Oscillator

Instead of a doubler and/or amplifier, some models have a 38-KHz oscillator to supply the reinsertion subcarrier signal. The oscillator is controlled by the 19-KHz pilot signal. The oscillator stage from a 1969 Delco unit is shown in Fig. 8. It's typical of all Delco models.

The oscillator is a Hartley. Feedback is from emitter to base through a coil tap in the tuned circuit. The input circuit includes two .02-mfd capacitors and the tuned circuit. The output circuit is a transformer tuned to 38 KHz. The block-form diagram in Fig. 8B shows all of these items.

From a DC standpoint, the collector is supplied through the primary of the output transformer. The emitter DC return is through the 1.5K resistor, the 390-ohm resistor and a small part of the input-coil winding. The base-bias circuit is through the 6.8K resistor.

The circuit oscillates naturally at 38 KHz because of the tuned output load. The 38-KHz feedback signal goes through the .07-mfd emitter bypass capacitor and the small part of the 19-KHz coil winding. The strong 19-KHz signal coming through the first input coupling ca-

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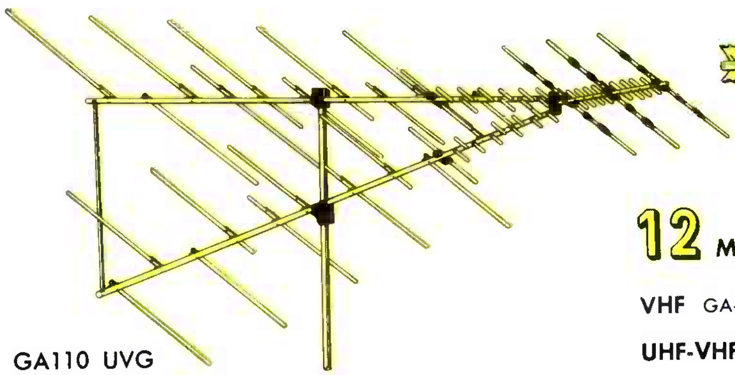

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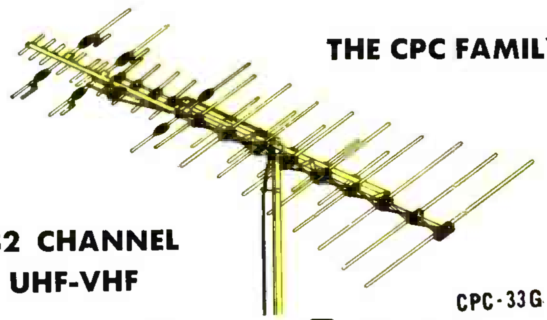

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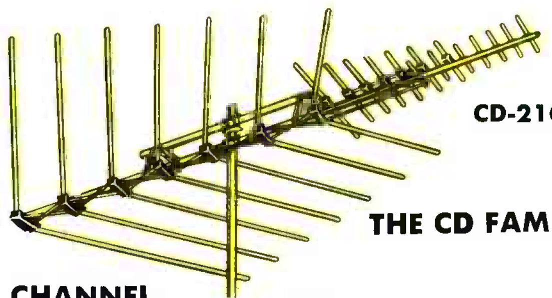

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pacitor keeps pulling the feedback energy into exact phase with the stereo-sync signal. Thus a precisely phase-locked signal is fed to the balanced detector. By the use of this signal the L − R sidebands can be demodulated accurately.

Buffer Amplifier

One broadband stage in almost every multiplex section passes along the L − R sidebands, which extend from as low as 23 KHz to as high as 53 KHz, and the L + R signals, which are frequencies between 50 and 15,000 Hz. Besides passing all those audio and above-audio frequencies without altering them, the buffer amplifier should block the 67-KHz signal (storecasting carrier) if a station uses it.

And, very important, the buffer-amplifier leg of the section controls the phase of the sideband and L + R signals. That's important because the relative phase between them and the reinserted subcarrier determines how good the stereo separation is. So, among the other circuits in a buffer stage, you may find a phase-shift circuit to set stereo-signal phase before it reaches the balanced detector.

Schematics of some buffer amplifier stages appear in Fig. 9. They are emitter followers. One function is to isolate the preceding stages and circuits from the phase-shift network. Most noticeable are the tuned trap circuits and the phase shifters.

The stages in Figs. 9A and B have 67-KHz traps in their input circuits. That blocks storecasting signals that might interfere with stereo programs. The stage at C is arranged differently. There's a trap in the input, but it's tuned to 53 KHz—right at the upper limit of any stereo sidebands. The 67-KHz trap in this stage is in one of the outputs. It's in the same circuit branch as the phase-shift network.

The base DC circuit for the stage at A is in the preceding stage. There's no capacitor between the two stages; they're DC coupled. DC circuits in the other two buffer-amplifier stages are simple and ordinary.

The output circuit shown in Fig. 9A has an adjustable phase-shift network. It comprises the 5.6K resistor, the .0022-mfd capacitor, the 1-mfd coupling electrolytic and the 10K potentiometer. The potentiometer is adjusted for best separation of the two audio channels. In other words, a signal in the transmitter's left channel shouldn't show up in the receiver's right channel.

The output circuit shown in Fig. 9B doesn't have even a phase-control arrangement. Phase is set by the 100-pf capacitor from base to ground.

The original schematic of the circuit in Fig. 9C might fool you if you didn't look at it carefully. The stage is labeled "19-KHz Amp." It does amplify the 19-KHz signal; the tuned output circuit feeds the signal on to a 38-KHz doubler. There's no amplification of signals in the emitter circuit, however. The stage does to the L + R signal and the L − R sidebands exactly what any buffer amplifier should do: It isolates them from other stages and circuits. In the emitter output circuit, phase is set mainly by a 220-pf and a .005-mfd capacitor, a 47K resistor and the 5K control in the emitter DC return circuit. The 2-mfd capacitor is mainly for coupling signals without passing DC. The correct setting of that 5K control is for best stereo separation.

Stereo-Indicator Sections

A lot of receivers now have lamps that indicate when a stereo broadcast signal is being received. There are several schemes for turning on the lamp. A few of them are shown schematically in Figs. 10 and 11. None are necessary to the operation of the receiver, but you should know how the circuits are arranged.

The first section, in Fig. 10A,

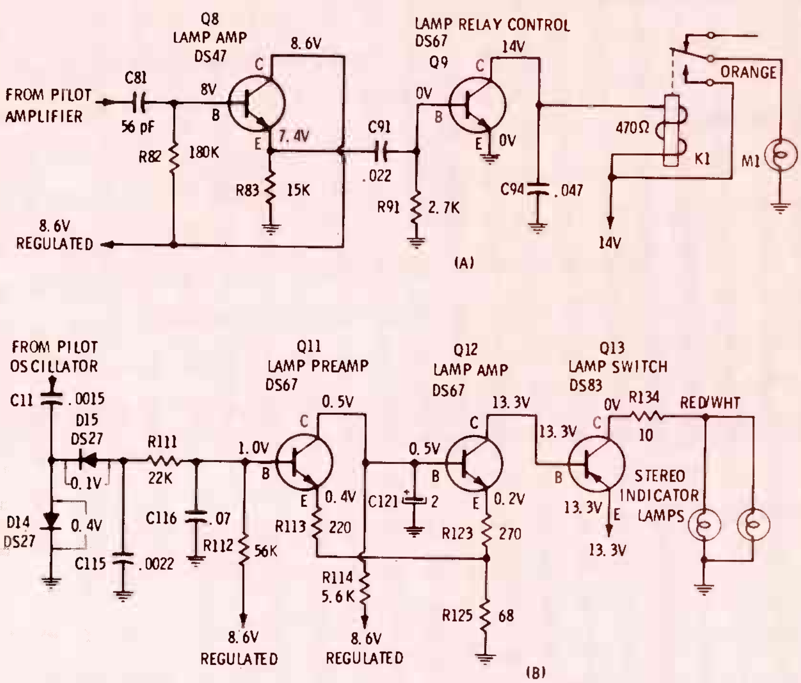

Fig. 10 Stereo-indicator light circuits. A) Actuated by pilot-amplifier signals. B) Acfuated by pilot oscillator.

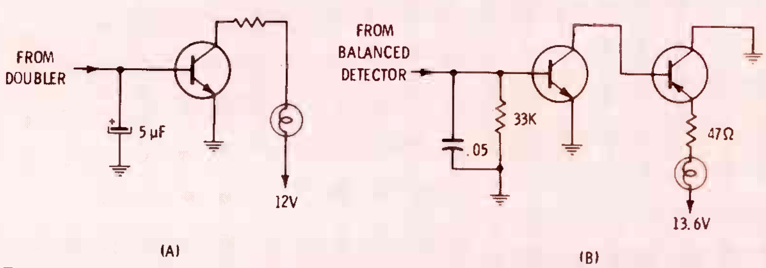

Fig. 11 Two simple stereo-light systems. A) Single stage design from a Tenna multiplex adapter. B) Two-stage design by Motorola.

Multiplex in Auto Radio,

continued

draws its signal from the pilot amplifier. The input circuit couples 19-KHz energy to the lamp amplifier stage, when a pilot carrier is present. The amplifier is an emitter follower, with only ordinary circuits. The output circuit of the control transistor is the coil of a relay; the same coil is the collector supply circuit. Bias on the control transistor changes whenever a drive signal reaches it from its input circuit. Collector direct current increases. The relay closes and applies 12 volts to the lamp.

The three stages in Fig. 10B are DC amplifiers. The pilot oscillator furnishes the activating energy. The 38-KHz signal is rectified by the twin-diode (D14 and D15) sensing stage. The negative-going change in DC voltage at the base of Q11 produces an opposite change at its collector. The base of Q12, connected directly to the Q11 collector, goes positive. This causes the voltage at the collector of Q12 and the base of Q13 to go negative. That makes Q13 conduct heavily. DC in the output circuit must go through the two stereo indicator lamps, and they light.

Most of the circuits in these three stages should be easy for you to figure out. Some are unfamiliar. The diodes are the first stage. The input circuit of the second stage, Q11, the first amplifier, is a filter. It smooths the DC produced by the two diodes. Collector supply for Q12 comes from the base-emitter action of Q13. The 2-mfd capacitor between Q11 and Q12 smooths out DC voltage changes that activate the lamp switch transistor.

The two stereo-lamp sections in Fig. 11 are exceptionally simple. Both work from DC voltages applied to the input transistor. The single-stage arrangement in Fig. 11A is triggered by the DC voltage developed in a two-diode frequency doubler.

The two-stage stereo indicator in Fig. 11B gets its DC input voltage from a balanced stereo detector. With direct coupling between the two stages, the change in DC voltage at the input is passed along to the second transistor. It draws heavy current and the lamp turns on. ▲

Troubleshooting Direct-Coupled Audio Circuits in Auto Radio

Interaction between cascaded stages can produce misleading and sometimes baffling DC voltage changes. The logical system of diagnosis presented in this article will help you steer clear of the confusion that can be caused by such interaction.

by Wayne Lemons

Until recent years, nearly every audio circuit was AC-coupled, which meant that a fault in one circuit usually did not cause drastic changes in the DC voltages in other circuits.

Direct-coupling, never very popular in tube or early transistor circuits, is now the rule rather than the exception. The reason is that a direct-coupled, high-gain circuit is possible with no large electrolytic coupling capacitors or interstage transformers required. Stabilization over several stages is also practical, and, because of low impedances and minimum phase shift, simple inverse audio feedback networks are feasible.

But because trouble in one portion of the circuit upsets the operation of succeeding stages and sometimes preceding stages, it is necessary to understand how the circuit will react before you can make an intelligent diagnosis of a fault.

One of the best ways to master a circuit is to try to predict—from the schematic—what will happen if some part goes bad. Fig. 1 is an example of a direct-coupled auto audio circuit. Can you predict what will happen to the collector current of Q3 if Q1 develops a collector-to-emitter short?

Look at the circuit and follow it through. First, if Q1 shorts from collector to emitter, the voltage at the collector would be grounded and, thus, reduced to zero. Since the collector of Q1 is tied directly to the base of Q2, its voltage also would be zero. With zero base voltage, Q2 would be cut off and there would be no collector current. With no collector current through Q2, there would be no voltage drop across R9. Resistor R9 is tied between the base and emitter of Q3 to provide bias, and if there were no voltage drop across R9, Q3 would also be zero-biased. With zero bias, the collector current of Q3 would drop to zero.

What would happen to the collector current of Q3 if Q2 opened? Again there would be no bias developed across R9, so the current through Q3 would drop to zero.

Now let's suppose that Q1 opens, what then? Again let's follow the circuit action. With Q1 open, the voltage on the collector would tend to go more positive because of the reduced current through R3. If it were not for Q2's base connection, the voltage would rise to +13 volts. Because of the base connection, there is still voltage drop across R3; however, the voltage drop would be less than before, and the base voltage on Q2 would go more positive. With a more positive base bias, the NPN transistor, Q2, will draw more collector current. This, in turn, increases the voltage drop across R9 and, so, increases the bias for the PNP germanium output transistor, Q3, and the collector current of Q3 will increase.

Under normal circumstances the increase in the collector current of Q3 would increase the voltage at its collector; this increased positive voltage would be fed through R2 and R5 to increase the bias on Q1 and, so, counteract the change. With Q1 open, however, the stabilization circuit has no control.

The designers have included two components to help limit the increase in output current should Q1 open. These are resistors R7 and R8. R7 limits the bias on Q2 because its voltage drop increases as the current of Q2 increases, thus tending to hold down the difference in base-to-emitter voltage on Q2. R8 also limits the total collector current flow.

R7 and R8 also help limit the current flow should Q2 short. With Q2 shorted, the maximum current flow from the +13-volt line to ground is limited to about 10 ma. This would product a voltage drop of about 0.56 volt across R9—still excessive for a germanium output transistor which normally operates at about 0.2 volt bias.

Oddly enough, excessive bias may not damage an output transistor as quickly as just a little too much bias. This is because the excessive bias causes the transistor to have a very small collector-to-emitter resistance and, since heat is based on I^2R, if R is low and the total current is limited, as it is here by the speaker and audio choke, the power dissipated by the transistor may be low enough to let it slip by without damage. Fig. 2 shows how this can happen in a hypothetical case. In this case, the normal bias causes the power dissipation of the transistor to be about 16 watts, while a little more bias increases it to 18 watts; however, sufficient bias to reduce the collector-emitter resistance to ½ ohm decreases the wattage dissipated by the transistor to just 12 watts. The external circuit heat goes up, and this is one of the main reasons for the audio choke. It provides a low DC resistance shunt while still maintaining a higher-than-the-speaker impedance for the audio.

Several manufacturers still use a small fusible resistor in the emitter circuit of the output transistor (Q3, Fig. 1) which will open if current exceeds a fixed amount, usually around 2 amperes in auto radio.

And now back to the circuit. To check yourself to see if you can predict what the circuit fault will be, answer the following questions (correct answers at the end of this article):

1. If R2 opens, the collector voltage of Q2 (measured to ground) will
   (1) increase
   (2) decrease
2. If C3 shorts, the collector voltage of Q1 will
   (1) increase
   (2) decrease
3. If R7 opens, the collector current of Q3 would
   (1) increase
   (2) decrease
   (3) remain the same
4. If R9 should open, the collector voltage of Q3 would
   (1) increase
   (2) decrease
   (3) remain virtually the same
   (4) not enough information to tell
5. If R6 should open, the base voltage of Q1 would
   (1) increase
   (2) decrease
   (3) not enough information to tell
6. If the voltage drop across R7 reads 4.1 volts, you might suspect that
   (1) Q1 is shorted
   (2) bias on Q1 is low
   (3) Q2 is open
   (4) R9 is open or changed to higher value
7. If the collector voltage of Q2 reads lower than normal, you might expect
   (1) the collector voltage of Q3 to be lower than normal
   (2) the bias of Q3 to be higher than normal
   (3) the emitter voltage of Q2 to be lower than normal
   (4) Q1 has excessive bias or is shorted

Troubleshooting Non-DC Faults

A voltmeter and a good understanding of how a circuit works will be just about all that's needed to find troubles in the DC portion of direct-coupled circuits. But what about the bypass capacitors? If one of them should short, the DC voltages will be upset and the voltmeter still will show up the trouble. But what if one opens? Two things can happen: one is a drastic loss in output volume and the other is motorboating, squeals, etc. For example, if C3 in Fig. 1 opens, the audio will not be filtered off the feedback path through R2 and R5. This audio from the collector of Q3 will be fed back to the base of Q1 with only about 30 percent attenuation. Since the two signals are 180 degrees out

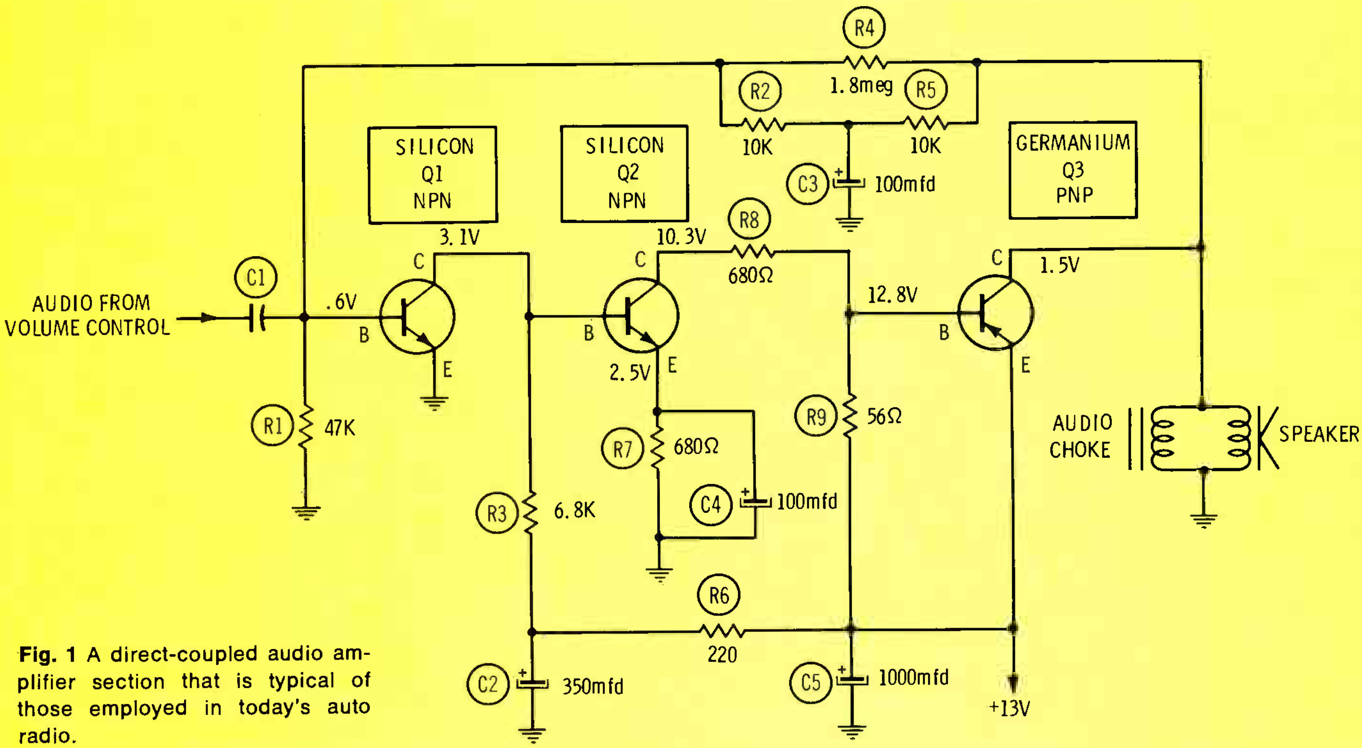

Fig. 1 A direct-coupled audio amplifier section that is typical of those employed in today's auto radio.

of phase, the gain of the amplifier will be reduced drastically.

There also will be a loss of gain if C4 in Fig. 1 should open. On the other hand, if C2 should open and if C5 did not do a real good job of bypassing, there could be a noticeable squeal in the speaker output.

Because different circuits will act differently when bypass capacitors open, and since there are only a few of them used, it is best in most cases to simply shunt them with a capacitor that is known to be good. If the trouble symptom disappears, you have found the trouble, and there is no more dramatic diagnosis than that.

Finally, when tracing direct-coupled circuits, remember that it requires an increase in positive bias (base-to-emitter voltage) to increase the current through an NPN transistor and an increase in negative bias to increase the current through a PNP type. Note that bias should always be measured between the base and emitter rather than to ground.

To determine the current a transistor is drawing, check the voltage drop across the emitter resistor. If no emitter resistor is used, you can measure the voltage drop across the collector resistor; however, remember that in direct-coupled circuits the collector resistor is also supplying some base current—normally not much, but if the collector is not drawing any current at all the base current of the following transistor may increase considerably.

Finally, every time a new direct-coupled circuit comes to your attention take a few minutes to try to predict what troubles will occur if any of the transistors open or short. This will help you develop an invaluable insight into possible troubles that can occur. Fortunately, present day silicon transistors seldom develop leakage resistance of consequence but are much more apt to completely open or short. This fact makes diagnosis considerably easier in direct-coupled circuits.

(Answers to troubleshooting questions on page 27)

1. (2) Decrease. With R2 open, there would be no bias on Q1, so the collector voltage of Q1 would increase, causing the bias and the current of Q2 also to increase, which, in turn, would increase the voltage drop across R9 and R8, lowering the voltage on the collector of Q2.
2. (1) Increase. With C3 shorted, the bias voltage on Q1 would be decreased, lowering the collector current through R3 and, in turn, increasing the collector voltage because of less drop across R3.
3. (2) Decrease. With R7 open, the collector current of Q2 would drop, lowering the voltage drop and decreasing the bias of Q3.
4. (4) Not enough information to tell. At first thought it would seem that with R9 open there would be no bias on Q3; however, if the leakage from collector to base of Q3 was low enough, there would be bias voltage from this source, and some collector current. Just how much collector current would be difficult to predict, although the chances are it would be reduced.
5. (2) Decrease. This is a little tricky. With R6 open, there would be no bias on Q2 and, so, no bias for Q3. The collector voltage of Q3 would drop and so would the bias of Q1, since it is supplied by the collector voltage of Q3.
6. (2) Bias on Q1 low. If the bias of Q1 is 'ow, the bias on Q2 would increase and, thus, increase the voltage drop across R7 because of the increased transistor current.
7. (2) The bias of Q3 would be higher than normal. If the collector voltage of Q2 is low, it probably means increased current through R8 and increased current through R9 and, so, more bias for Q3. ▲

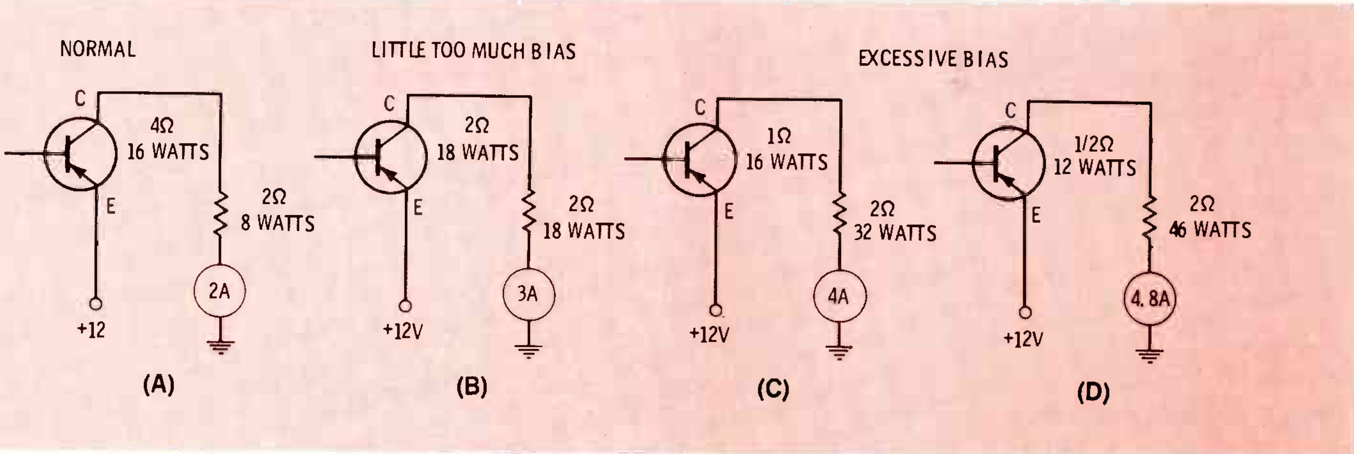

Fig. 2 The sequence of operating conditions shown here help explain how in some cases an excessive amount of forward bias will not destroy a transistor. (A) normal forward bias. (B) slightly above normal forward bias. (C) excessive forward bias—power dissipation of transistor has returned to normal, but power dissipated by load resistor is four times normal. (D) increased excessive forward bias—power dissipation of transistor actually is below normal, while power dissipated by load resistor is nearly six times normal, collector-to-emitter resistance of transistor is ⅛ of normal value.

testequipment

notes on analysis of test instruments, their operation and applications

In-Circuit Transistor Checker

Leader Model LTC-901 is a multifunction instrument used for both in-circuit and out-of-circuit transistor checking. Beta and Iceo of transistors as well as diode quality can be determined.

A special section of the instrument performs the function of a signal tracer for both AF and RF applications. This section is made up of an oscillator, signal injector, RF/AF detector probe and a high-gain transistorized audio amplifier with a small loudspeaker for audible indication. The unit is battery-powered.

Specifications of the unit are:

Ranges:

Transistor Beta	0-100 and 0-200 + or – 10% full-scale deflection
Iceo	0-1 ma, + or –10%
Voltage	0-20V DC 1K ohms/volt.
Current	0-50 ma DC.
Signal tracer	Output 100mW; Gain 90 db.
Tracer Probe	Impedance: AF 100K ohms, RF 50K ohms
Signal Injector	1kHz and harmonics
Accessories	7 test leads

Price is $69.00.

Circle 60 on literature card

Color Bar-Pattern Generator

Fifteen patterns for adjusting color TV receivers are supplied by the Leader Instruments Corporation solid-state Model LCG-388 generator. Patterns available include: rainbow; gated rainbow with only one red, one blue and one green bar; gated rainbow with the normal 10 bars; dots; crosshatch; vertical lines; and horizontal lines with either one, three, or the normal number of lines or dots.

Front panel controls are: Pattern selector, color amplitude control, three gun-killer switches, variable video of both polarities, and vertical or horizontal trigger pulses for scope synchronization.

The oscillators are crystal-controlled, with the dividers using flip-flop and logic circuitry to generate stable signal frequencies. According to the manufacturer, progressive scanning is used to prevent horizontal line flicker, and the regulated power supply should eliminate the effects of line-voltage variation.

The Model LCG-388 generator is priced at $149.00.

Circle 61 on literature card

▲

Circle 15 on literature card

Circle 16 on literature card

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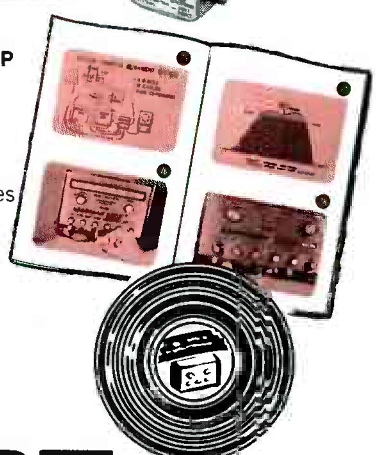
80 full color reproductions direct from Sencore technical training film clearly depicts alignment from beginning to end using SM152. Pictures are numbered so you can review a section at a time if you are in trouble. 35 minute LP record direct from film clearly leads you all the way. Also packed with each SM152. Numbers are announced for each picture so you can review a section when necessary.



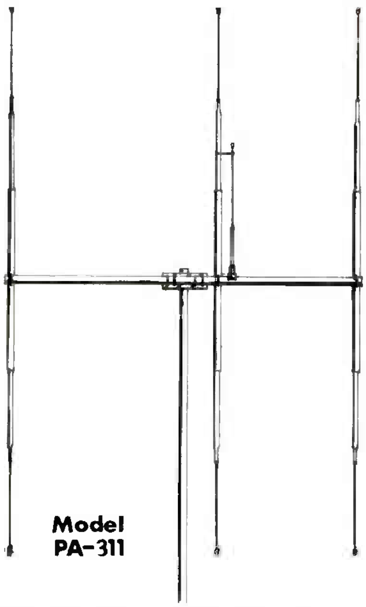
SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

antenna systems report

Three-Element CB Beam Antenna



Mosley Electronics, Inc., has introduced a three-element beam antenna for Citizens Band Radio. The Paragon Beam (Model PA-311) features a three-piece boom and perfectly balanced elements with swaged tubing to reduce vibration in the wind. Its improved gamma-matching system includes a molded gamma base and connector for greater convenience and durability, according to the manufacturer.

Forward Gain: 8 dB compared to reference dipole; 10.1 dB over isotropic source.
Front-to-Back Ratio: 24 dB.
SWR: 1.5/1 or better.
Type of Match: Gamma.
Feed Point Impedance: 52 ohms, nominal.
Radiation: Uni-directional.
Model PA-311 has a maximum length of 19′ 2½″ and a boom length of 12′. The price of the antenna is $46.65.

Circle 62 on literature card

Antenna Replacement Elements

Audiotex-Home Electronics has introduced TV antenna replacement elements. The new replacement elements are available in two sizes—a 4-section unit and a 5-section unit, both extending to 38″.

The new elements are individually skin-packed, and supplied with a retainer screw. Complete mounting instructions are shown on the package.

The price of the 4-section unit is $2.48; the 5-section, $2.98. ▲

Circle 63 on literature card

Circle 18 on literature card

Circle 45 on literature card

Weller®

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Weller has done more than anyone else to simplify soldering. Weller innovations began with the soldering gun. And they've continued ever since. With the development of new tools and advanced features. All designed to give dependable, noise-free soldered connections quickly, efficiently and easily. Is there any wonder why more service technicians use Weller than any other soldering tools?

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Preferred by technicians for their unmatched benefits. Tip heats instantly when trigger is pulled. Two trigger positions permit instant switching to low or high heat. Low heat prevents damage to sensitive components, yet high heat is there when you need it. Gun also offers high soldering efficiency, long-life copper tip, spotlight, perfect balance and maximum operating comfort.

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Model D-440 145/210 watts
Model D-550 240/325 watts

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MODEL GT-6B comes with 600°F 1⁄8″ conical point Powerhead

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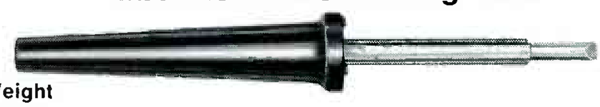
Model W-PS with 1⁄16″ tip.

MARKSMAN Soldering Irons



Model No.	Watts/ 120V	Weight
SP-23	25	1¾ oz.
SP-40	40	2 oz.
SP-80	80	4 oz.
SP-120	120	10 oz.
SP-175	175	16 oz.

Ideal for deep chassis work, the caddy, and on-the-job soldering. Marksman irons outperform all others of their size and weight. All models feature stainless steel barrel and replaceable tip.

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Circle 19 on literature card

Isolating Indirect Causes of Weak Vertical Sync

A low-pass filter and your scope enable you to isolate the causes of weak vertical sync that occur outside of the vertical oscillator and output stages.

by Carl Babcoke

Vertical sync can be an elusive and mysterious signal to troubleshoot since it is actually formed by a narrowing and broadening of the horizontal sync pulse transmitted by the television station. (Refer to "Vertical Sync Simplified" in the September '69 issue of Electronic Servicing for more details.) Many hours have been wasted when a technician wrongly concluded that weak vertical locking must be caused by a vertical sweep defect since the **horizontal** sync did not have contamination from the video, but was normal in waveshape and amplitude. It is very possible for horizontal sync to be perfect, yet for the vertical sync to be weak. The source of this phenomena is usually found **before** the sync separator. A triggered scope would permit us to look at the serrated vertical sync pulses in the video signal, but there is an easier method that works fine with any scope (even one with narrow bandwidth) and does not require critical evaluation.

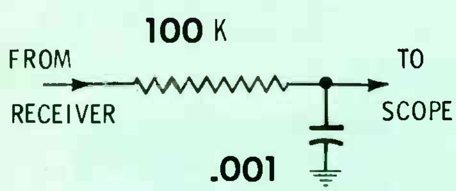


Fig. 1 Values of a simple low-pass filter to be used between the chassis and scope. The vertical sync can be displayed directly on the scope screen.

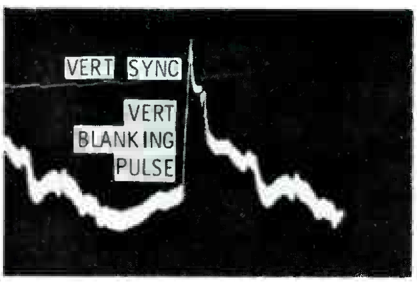


Fig. 2 Normal vertical sync at a positive-going video detector. The sync pulse (on top of the vertical blanking pedestal) is about 30% of the total height.

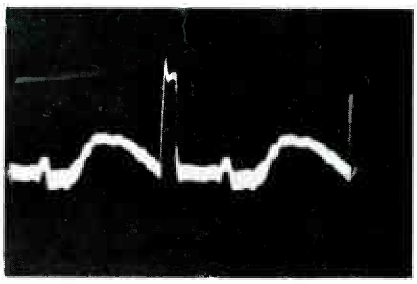


Fig. 3 The vertical sync has been weakened by an AGC overload problem.

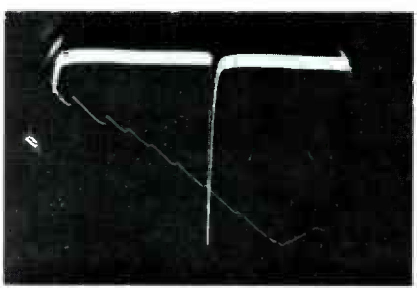


Fig. 4 Vertical sync at the plate of the sync separator; the amplitude is about 30 volts peak-to-peak, or about one-half that of the horizontal pulses.

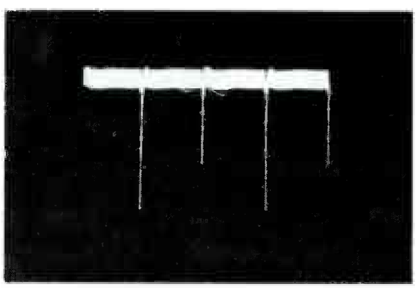


Fig. 5 Vertical "shimmy" is caused by weak alternate vertical sync pulses. The defect is most likely to be an open AGC bypass capacitor.

The Technique

Fig. 1 is the schematic of a low-pass filter which will eliminate most of the video, horizontal sync and horizontal blanking so only the vertical sync remains. Values of the low-pass filter have been carefully determined by experimentation to produce maximum height of the sync and still accomplish integration of the serrated pulses.

The pulse in Fig. 2 is the vertical blanking waveform, and the sawtooth on top is the vertical sync signal that has been integrated by the low-pass filter. Different video waveforms affect the height of the vertical blanking pulse, but the full size will be seen if you watch the scope pattern for a short time. The amplitude of the vertical sync sawtooth should remain constant; any variation indicates an intermittent defect.

Fig. 3 shows the vertical sync reduced in amplitude by an AGC problem. Horizontal locking was still normal.

Vertical sync can be checked anywhere in the video circuit, from the video detector to the picture tube, by using the low-pass filter and the scope. The polarity will be inverted as we go from grid (or base) to plate (or collector) of each stage. Of course, whatever happens to the sync after the sync separator input signal is taken off is of no importance. Color receivers often have very little sync in the last video amplifier because of black-level compression. This is one of the reasons why retrace blanking is so much more necessary in a color receiver: vertical and horizontal blanking pulses are compressed severely in the last video amplifier.

Common Indirect Causes of Weak Vertical Sync

Electrolytic capacitors used as bypasses in video stages can cause a loss of vertical sync; this type of trouble can be very hard to find. A good example is the 2-mfd capacitor used from screen to cathode in the first video amplifier stage in RCA chassis CTC7 through CTC11, inclusive. High internal series resistance was the apparent defect, since most of the symptoms disappeared if the capacitor was clipped loose. In addition to the virtual loss of vertical sync, many sets also showed a smeared picture. With others, the vertical would lock with the vertical blanking bar too far up from the bottom of the raster. This indicates a large error in the phase of the vertical sync and is always associated with a defective electrolytic.

Power supply filters are another suspect in cases of weak vertical sync, although other symptoms often accompany it. A raster with dark shading on one side and horizontal pulling are two of the more common associated symptoms.

Weak vertical sync at the video detector is most often the result of a marginal overload condition in the tuner or IF stages, and it should be analyzed as an AGC problem. Poor alignment of the IF stages, especially if the picture carrier side of the curve is too steep, can weaken vertical sync and require careful adjusting of the fine tuning to obtain vertical locking.

Another seldom-suspected vertical sync defect can be caused by poor filtering of the AGC voltage applied to the tuner or IF stages. This can be caused by reduced value of an AGC resistor, but is more likely to be caused by an open AGC bypass capacitor. Often the only symptom of an open capacitor will be weak or soft vertical locking. To avoid inconclusive test results, it is advisable to view the vertical sync at the video detector while you parallel each AGC capacitor with a new one of like value. Don't depend upon checking the locking by adjusting the vertical hold control.

The low-pass filter shown in Fig. 1 also permits us to see the vertical sync signal at the output of the sync separator. Of course, the waveform will be different since the vertical blanking is eliminated by the clipping action, and only a large vertical spike (see Fig. 4) will be seen. Expect this spike to be approximately 50% of the horizontal sync amplitude measured before the filter. Record the amplitude of both these signals on several different models, and average them to give a standard for future vertical sync problems.

Following the sync separator stage, the vertical sync pulses go through the integrator (low-pass filter) to the grid, plate or cathode of the vertical oscillator. Leakage in the integrator capacitor or an increase in the resistor will weaken the sync before it reaches the oscillator. One of the quick-and-dirty solutions for weak vertical sync is to reduce the size of the integrator resistor. A good rule-of-thumb is to avoid reducing the resistor to less than half the original size; to go farther may cause vertical "shimmy".

Vertical shimmy is a small up and down movement of the entire picture thirty times every second, and is caused by horizontal pulses (usually horizontal sweep voltages) getting into the wrong circuits. The horizontal pulses at the plate (or collector) of the AGC keyer can cause vertical shimmy if they are not filtered out completely from the AGC controlled stages. Fig. 5 shows the reason for the shimmy. Alternate sync pulses are weak in amplitude. The vertical locks on the strong sync pulse and starts to roll on the weak one, thus causing the vertical motion. Other cases of shimmy have been traced to a defective capacitor component in the vertical positive feedback path that permitted the horizontal pulses from the yoke to reach the vertical oscillator.

Very few cases of weak vertical locking originate in the vertical sweep circuit (oscillator and output stages). But a weak output stage that requires the oscillator to furnish more than the normal amplitude of drive will cause soft locking. The usual sync amplitude is too low compared to the abnormally high sweep voltage. Reduce the height and linearity controls slightly and notice the improvement in locking. A normal receiver will have slightly better locking; any undue improvement would indicate weak sweep. ▲

Source guide to imported consumer electronic products

A source guide to imported consumer electronic products was published in the February '69 issue of ELECTRONIC SERVICING. Since then, we have learned of many new brands. After considerable research, we now have determined the importer and/or distributors of these new brands and have included them all in this updated Source Guide To Imported Consumer Electronic Products.

This guide correlates the brand name of an imported product with the importer and/or distributor of that product and indicates whether or not that brand name is or has been covered in Howard W. Sams specialized series of transistor radios, auto radios and tape recorders (TSM, AR and TR series) or in PHOTOFACT.

The number following each brand name indicates the most likely source from which service information and/or parts may be obtained, or to which a set may be sent for repair service. Before shipping a set, it is best to write the company indicated to determine if repair service is available, and if it is, what the company rules are concerning shipment of the set.

We have attempted to list only those brand names that are still being marketed in this country.

To provide continuous updating of this source guide, the editors of ELECTRONIC SERVICING would appreciate receiving from readers other brand names that are being used but do not appear here. If the importer and/or distributor is known, please include it. If it is not known, we will attempt to trace it and publish the information in ELECTRONIC SERVICING.

Complete Importer/Distributor list beginning on page 42

Brand Name	Importer and/or Distributor	Sams Coverage
ACME	150	yes
AMC (Aimcee)	5	yes
AMC (York)	273	no
AMD	269	no
Adonis	3	no
Advanco	4	no
Aimor	2, 34	no
Aircastle	224	yes
Aircorder	203	no
Airline	168	yes
Aiwa	6	yes
Aiwa (Rand)	204	yes
Aiwa (Selectron)	214	yes
Akai (Camart)	45	no
Akai (Roberts)	207	no
Alaron	31	yes
Alliance	8	yes
Alps	11	no
Ambassador	10, 159	yes
Amertone	12	no
Amico	80	no
Angel	18	no
Annabel	31	no
Apolec	2	yes
Aristo	17	no
Aristocrat	28	yes
Aristo-Tone	17	no
Arrow	18	no
Arvin	20	yes
Astrotone	137	yes
Audion	25	no
Audiopak	24	no
Audiotape	24	no
Aud-I-Tone	124	yes
Audovox	26	yes
Automatic	27	yes
Autosonic	152	yes
Aztec	30	no
BSR	32	yes
Belaic	90	no
Belair (Hamway)	106	no
Belair (Mason)	154	no
Belair (Toko)	247	no
Belaire	90	no
Belcor	33	no
Belcorder	106	no

Brand Name	Importer and/or Distributor	Sams Coverage	Brand Name	Importer and/or Distributor	Sams Coverage	Brand Name	Importer and/or Distributor	Sams Coverage
Benjamin	35	yes	Denon (Nippon Columbia)	182	no	Gaytone	106	no
Berlitz	23	no	Denon (Sheraton)	216	no	Geloso	13	yes
Birch	240	yes	Dia	184	no	Gema	21	no
Blaupunkt	37	yes	Dimension	242	no	General	256	yes
Boman	42	no	Dokorder (Pengo)	197	no	Global	97	yes
Bradford	100	yes	Dokorder (Wilson)	268	no	Globe	94	yes
Brenell	84	no	Domino	184	no	Goer	98	no
Brightone	1	no	Doral	97	no	Goer 8	51	no
Broadmoor	40	yes	Dorset	243	no	Gotham	99	yes
Browni	53	no	Douglas	222	yes	Granada	90	no
Bulova	41	yes	Drexel	71	yes	Grand Prix	53	no
Bush	256	no	Dyn	72	no	Gregory	101	yes
Califco	43	yes	Dyn-Sonic	72	no	Grundig	102	yes
Cameo	20	yes	Ebner	84	no	Guy Barry	82	no
Candle	46	yes	Elac	35	no	HTV	105	no
Capri (Nason)	173	no	Eldorado	56	no	Halco	104	no
Capri (Toepfer)	245	no	Electra	73	no	Harlie	107	no
Channel Master	52	yes	Electro	74	yes	Harp	89	no
Chemicon	181	no	Electro-Brand	74	yes	Hemisphere	209	yes
Cipher	160	yes	Electrohome	121	yes	Heritage	109	no
Clairtone	54	yes	Electrophonic	75	no	Hi-Delity	199	yes
Claricon	269	yes	Elgin	76	yes	Highwave (Delmonico)	70	yes
Clarion	269	yes	Emerson	77	yes	Highwave (Marvel)	153	yes
Clasonic	55	no	Emi	35	no	Hit	109	no
Columbia	57	yes	Empire	253	no	Hitachi	111, 112	yes
Commodore	58	yes	Encore	44	no	Hitachi (Hitachi Maxell)	110	yes
Concertone	59	yes	Engineers	208	no	Hitachi (Thal)	244	yes
Concertone (Monarch)	167	no	Englishtown	224	yes	Hiwave	154	no
Concord	60	yes	Essex	140, 141	yes	Hokuyo Musen	113	no
Constant	47	no	Ever-Play	103	yes	Honey Tone	21	yes
Consul Delux	96	no	Fabullcyds	140, 141	no	Hosho	60	yes
Contelcee	62	no	Facom	92	no	ISCO	118	yes
Coronet	18	yes	Faircrest	85	yes	ITC (Ikegami)	115	no
Corvair	257	yes	Fairmont	82	yes	ITC (Int'l Transistor)	122	no
Corvette	162	yes	Fanon	83	yes	ITT	114	yes
Craig	64	yes	Fanuc	92	no	Imperial	116	yes
Crest	245	yes	Fen-Tone	84	no	Imperial Delux	116	no
Crest-Line	47	no	Fidelity	208	no	Impex	117	no
Crown	66	yes	Fleetwood	258	yes	Inland	119	yes
Crown (Ansafone)	15	no	Foster	88	no	Intermart	120	no
Crown (Industrial Suppliers)	118	yes	Four Star	87	no	Invico	49	no
Crowncorder	66	no	Fuji	91	no	Invicta	252	yes
Daltone	67	no	Fujitsu	92	no	JFD	123	yes
Decca	68	yes	Funai	93	no	JJJ	124	no
Dejay	69	no	GW	95	no	JVC	125	no
Delmonico	70	yes	Galaxy	21	no	JVC (Delmonico)	70	no

more . . .

Source guide, continued

Brand Name	Importer and/or Distributor	Sams Coverage	Brand Name	Importer and/or Distributor	Sams Coverage	Brand Name	Importer and/or Distributor	Sams Coverage
Jade	205	no	Mercury	158	yes	Panasonic	195	yes
Jaguar	175	yes	Message Minder	38	no	Panger	242	no
Jeolco	126	no	Metex	184	no	Peerless	196	yes
Juliette	249	yes	Midland	162	yes	Pencorder	201	no
KCK	127	no	Miharu	163	no	Penncrest	198	yes
Katone	129	no	Mikado	164	no	Petely	199	no
Kaysons	131	no	Mini-Swinger	240	no	Peter Pan	240	no
Kensington	243	no	Miny	185	no	Petite	229	yes
Kent	132	yes	Miracord	35	yes	Phoenix	44	no
Kenwood	133	yes	Mirandette	9	no	Pioneer	200	no
Kenwood (Trio)	259	yes	Mitsubishi	165	yes	Plata (Dyn)	72	yes
Keystone	23	no	Mitsumi	166	no	Plata (Kaysons)	131	yes
Koronette	86	no	Mody-Kit	39	no	Playtape	65	no
Kowa	134	yes	Monarch	167	yes	President	196	no
Koyo	135	yes	Monarch (BSR)	32	yes	Raleigh	131	yes
Kroy	273	yes	Monacor	167	yes	Ranger	242	yes
Kupi-Tone	267	no	Morse	169	yes	Realistic	202	yes
Kyocera	136	no	Murata	170	no	Realtone	205	yes
LIC	143	no	NACO	185	no	Rembrandt Antennas	7	yes
Lafayette	137	yes	NGK	171	no	Rhapsody	31	yes
Leader	138	no	NTK	171	no	Rivera	174	no
Leak	79	yes	Nakamichi	172	no	Roberts	207	yes
Lexington	201	yes	National	195	yes	Roberts Ross	244	no
Lion	139	no	Nec (Kanematsu)	128	yes	Robette	108	no
Little Pal	150	no	Nec (Nippon Electric)	183	yes	Robin	154	yes
Lloyd's	140	yes	Net	176	no	Ross	208	yes
Lucky	143	no	Newell	2	no	Royal	149	yes
Luxtone	144	no	Nichicon	179	no	SD	233	no
Lynn	145	no	Nivico (Challenge)	49	no	SMK	220	no
MYM	146	no	Nivico (Delmonico)	70	no	Sampson	121	yes
Magnavox	148	yes	Nobility	177	no	Sandhurst	3	no
Magnifique	208	no	Normende	229	yes	San-ei Instrument	210	no
Major	149	no	Norelco	186	yes	Sankyo	14	no
Majorette	149	yes	North American	185	yes	Sansui	212	yes
Mantone	150	no	Novel	91	no	Sanyo	213	no
Martel	152	no	NuVox	187	no	Satellite	36	yes
Marvel	150	yes	OKI	50	yes	Saxony	255	yes
Mascot	208	yes	OMGS	185	yes	Scene Tuner	51	no
Mastercraft	155	yes	Olson	189	no	Seavox	90	no
Masterwork	156	yes	Olympic	190	yes	Seminole	211	yes
Masterwork (Columbia)	57	yes	Omron	191	no	Sentry	23	no
Matsushita	157	yes	Onkyo	193	no	Sharp	215	yes
Maxell	110	no	Orion	192	yes	Sheraton	216	yes
Mayfair	19	yes	Orion (Fried Trading)	90	yes	Shibaden	217	yes
Megatone	3	no	Pacific	194	no	Shimadzu	218	no

Brand Name	Importer and/or Distributor	Sams Coverage
Shin-Shirasuna	219	no
Singer	221	yes
Skymaster	177	no
Sony	223	yes
Soundesign	205	yes
Sovereign	216	no
Spica	230	yes
Sportmaster	225	yes
Squealer	51	no
Stanbrooke	243	no
Standard	226, 227	yes
Stanford	228	no
Starfire	151	no
Star-Lite	155	yes
Stellar	22	no
Stereo-Dyn	72	no
Stereomatic	3	no
Stewart	145	yes
St. Moritz	150	no
Summit	230	no
Sun Glass	13	no
Suora	71	no
Super Dynamic	233	no
Superex	231	yes
Supersonic	224	yes
Supre-Macy	147	yes
Sylvano	16	no
Symphonette	142	yes
Symphonic	232	yes
TDK	233	no
TDK Cassette	233	no
TMK	252	no
TWI	258	no
Tact (Fried Trading)	90	no
Tact (Hamway)	106	no
Takt	234	no
Tamradio	235	no
Tamura	236	no
Tandberg	237	yes
Teac	238	no
Teac (Repair Center)	206	no
Technicorder	188	no
Telefunken	239	yes
Tele-Tone	240	yes
Telmar	241	no
Telmar (Martel)	152	no
Tempest	29	no
Ten (Fujitsu)	92	yes
Ten (Sanyo)	213	yes
Tennamatic	242	no
Three-Star	173	no
Tobi-Sonic	19	no
Toho	248	no
Tokai	246	yes
Toko	247	no
Tonecrest	161	yes
Tonemaster (Broadmoor)	40	yes
Tonemaster (TAC)	256	yes
Tonex	44	no
Toshiba	250	yes
Toshiba (Transistor World)	257	yes
Townley	78	no
Trancel	257	yes
Transette	162	yes
Transonic	257	yes
Trio	259	no
Tropicana	34	no
Truetone	266	yes
Tussah	261	no
Uher	152	yes
Unicord	13	no
Valiant	262	yes
Vantage	81	yes
Vesper	246	yes
Viscount	61	yes
Vista	63	yes
Voca	264	no
Vornado	265	yes
Watham	121, 209	yes
Wealth (Funai)	93	no
Wealth (Toyomenka)	252	no
Wilco	213	yes
Wilson	268	no
Winston	252	yes
Yamatake-Honeywell	270	no
Yaskawa	271	no
Yec	274	no
Yew	272	no
York	273	yes
York (N.Y. Transistor)	178	yes

Complete Importer/Distributor list beginning on page 42

Importer/Distributor List

1. A & A Trading Co.
23 East 26th St.
New York, N.Y.

2. ABC Import & Export
47 West 30th St.
New York, N.Y.

3. A & S Trading Co.
124 West 30th St.
New York, N.Y. 10001

4. Advance Transistor Co.
1225 Broadway
New York, N.Y.

5. Aimcee Wholesale Corp.
1440 Broadway
New York, N.Y. 10018

6. Aiwa International Corp.
One East Wacker Drive
Chicago, Ill. 60611

7. All Channel Products Corp.
47-75 48th St.
Woodside, N.Y.

8. Alliance Mfg. Co. Ltd.
Lake Park Blvd.
Alliance, Ohio

9. Allied Impex Corp.
300 Park Ave. South
New York, N.Y.

10. Allied Stores Purchasing
401 Fifth Ave.
New York, N.Y.

11. Alps Electric Co. Ltd.
c/o Kanematsu-Gosho (USA) Inc.
One Whitehall St.
New York, N.Y. 10004

12. Amerex Trading Co.
417 Fifth Ave.
New York, N.Y.

13. American Geloso Electronics, Inc.
251 Park Ave. South
New York, N.Y. 10010

14. American Sankyo Corp.
95 Madison Ave.
New York, N.Y. 10016

15. Ansafone of New York
41 East 11th St.
New York, N.Y.

16. Apex Repair Center
1141 Broadway
New York, N.Y.

17. Aristo-Tone Electronics
240 Fifth Ave.
New York, N.Y. 10001

18. Arrow Trading Co.
7 West 26th St.
New York, N.Y.

19. Artic Import Co.
(Bee Electronics)
(Mayfair Electronics Corp.)
666 West Kinzie St.
Chicago, Ill. 60610

20. Arvin Industries, Inc.
1531 13th St.
Columbus, Ind. 47201

21. Associated Importers
34 Dore St.
San Francisco, Calif.

22. Astra Trading Co.
175 Fifth Ave.
New York, N.Y. 10010

23. Atlas Rand Corp.
One Keystone Rd.
Paramus, N.J.

24. Audio Devices Inc.
235 East 42nd St.
New York, N.Y.

25. Audion Corp.
200 Fifth Ave.
New York, N.Y.

26. Audovox Corp.
156 Fifth Ave.
New York, N.Y.

27. Automatic Radio Sales
2 Main St.
Melrose, Mass.

28. Automotive Associates
551 Fifth Ave.
New York, N.Y. 10017

29. Azad International
22 West 27th St.
New York, N.Y.

30. Aztec Sound Corp.
2140 South Lipan St.
Denver, Colo.

31. B & B Import & Export Co.
15755 Wyoming Ave.
Detroit, Mich. 48238

32. B.S.R. (USA) Ltd.
Route 33
Blauvelt, N.Y. 10913

33. Belcor Corp.
457 Chancellor Ave.
Newark, N.J.

34. Bell Electronics
1180 Broadway
New York, N.Y. 10009

35. Benjamin Electronic Sound Co.
40 Smith St.
Farmingdale, L.I., N.Y. 11735

36. Best of Tokyo
11 West 42nd St.
New York, N.Y.

37. Robert Bosch Corp.
40-25 Crescent St.
Long Island City, N.Y. 11101

38. Boston Worldwide
148 State St.
Boston, Mass.

39. Bowman Electronics
155 East First Ave.
Roselle, N.J.

40. Broadmoor Industries Ltd.
530 Santa Rosa Dr.
Des Plaines, Ill. 60018

41. Bulova Watch Co.
630 Fifth Ave.
New York, N.Y. 10020

42. California Auto Radio Inc.
1229 South Woodruff St.
Downey, Calif.

43. California Trading Co.
P. O. Box 3164
Torrance, Calif.

44. Caltrade Mfg. & Trading Co.
360 9th St.
San Francisco, Calif. 94103

45. Camart Products Repair Center
1845 Broadway
New York, N.Y.

46. Candle America, Inc.
1457 Venice Blvd.
Los Angeles, Calif. 90006

47. Canton-Son, Inc.
12 West 27th St.
New York, N.Y.

48. Cardinal Electronics
5069 Broadway
New York, N.Y.

49. Challenge Corp.
150 Fifth Ave.
New York, N.Y.

50. Chancellor Electronics, Inc.
457 Chancellor Ave.
Newark, N.J. 07112

51. Channel Marketing Inc.
342 Madison Ave.
New York, N.Y.

52. Channel Master
Ellenville
New York, N.Y.

53. Charles Brown & Co.
1170 Broadway
New York, N.Y. 10001

54. Clairtone Electronic Corp.
681 Fifth Ave.
New York, N.Y. 10022

55. Clarion Shoji Co., Ltd. (USA)
2306 Cotner Ave.
Los Angeles, Calif. 90064

56. A. Cohen & Sons, Inc.
27 West 23rd St.
New York, N.Y. 10010

57. Columbia Records Corp.
51 West 52nd St.
New York, N.Y. 10019

58. Commodore Import Corp.
507 Flushing Ave.
Brooklyn, N.Y. 11205

59. Concertone, Inc.
3962 Landmark St.
Culver City, Calif. 90230

60. Concord Electronics Corp.
1935 Arnacost Ave.
West Los Angeles, Calif. 90025

61. Consolidated Merchandise Corp.
520 West 34th St.
New York, N.Y. 10001

62. Continental Telephone Answering Devices
17 West 46th St.
New York, N.Y.

63. Craig Corp.
2302 East 15th St.
Los Angeles, Calif. 90021

64. Craig Corp.
Cardinal Electric
5069 Broadway
New York, N.Y.

65. Craigstan Corp.
1115 Broadway
New York, N.Y.

66. Crown Radio Corp.
755 Folsom St.
San Francisco, Calif. 94107

67. Dalamal & Sons
107 Franklin
New York, N.Y. 10002

68. Decca Distributing
445 Park Ave.
New York, N.Y. 10022

69. Dejay Industries
90 North Washington St.
Boston, Mass.

70. Delmonico International
50-35 56th Rd.
Maspeth, L.I., N.Y. 11378

71. Drexel Radio Corp.
P. O. Box 15156
New Orleans, La.

72. Dyn Assoc. Importers, Inc.
270 West 22nd St.
Hialeah, Fla. 33010

73. Electra Radio Corp.
30 West 23rd St.
New York, N.Y.

74. Electro-Brand, Inc.
210 West Chestnut
Chicago, Ill. 60610

75. Electrophonic Corp.
9200 Atlantic Ave.
Ozone Park, N.Y.

76. Elgin National Watch Co.
841 West Jackson Blvd.
Chicago, Ill.

77. Emerson TV & Radio Co.
51 West 51st St.
New York, N.Y.

78. The Englishtown Corp.
42 Broadway
New York, N.Y. 10004

79. Ercona Corp.
432 Park Ave. South
New York, N.Y. 10016

80. Exhibit Sales Co.
South 3rd St.
Philadelphia, Pa. 19106

81. Fairfax Distributing Co. Inc.
1328 New York Ave. NW
Washington, D.C.

82. Fairmont Electronics
12 Crescent St.
Holyoke, Mass.

83. Fanon Electronic Ind.
439 Frelinghuysen Ave.
Newark, N.J. 07114

84. Fen Tone International
106 Fifth Ave.
New York, N.Y. 10011

85. J. M. Fields
111 8th Ave.
New York, N.Y.

86. Fisher Sonic Co., Inc.
405 44th St.
Brooklyn, N.Y.

87. Fortune Star Products
1207 Broadway
New York, N.Y. 10001

88. Foster Electric Co., Ltd.
230 North Michigan Ave.
Chicago, Ill. 60601

89. L. K. Franklin Co.
8912 West Olympic Blvd.
Beverly Hills, Calif.

90. Fried Trading Co.
425 Bedford Ave.
Brooklyn, N.Y. 11211

91. Fuji Electrochemical Co., Ltd.
437 Fifth Ave.
New York, N.Y. 10016

92. Fujitsu Ltd.
680 Fifth Ave.
New York, N.Y. 10019

93. Funai Electric Co., Ltd.
3004 West Logan Blvd.
Chicago, Ill. 60647

94. GC Electronics Co.
400 South Wyman St.
Rockford, Ill.

95. GW Electronics, Inc.
1647-4 West Sepulveda Blvd.
Torrance, Calif.

96. General Consolidated
87 Dell Gen Ave.
Lodi, N.J.

97. Global Import & Export
858 West Flagler St.
Miami, Fla. 33130

98. Goodway, Inc.
11401 Roosevelt Blvd.
Philadelphia, Pa.

99. Gotham Electronics Inc.
170 Michael Dr.
Syosset, N.Y. 11791

100. W. T. Grant Co.
1441 Broadway
New York, N.Y. 10018

101. Gregory Amplifier Corp.
3650 Dyre Ave.
Bronx, N.Y.

102. Grundig Electronic Sales Corp.
355 Lexington Ave.
New York, N.Y.

103. Gulton Industries
212 Durham Ave.
Metuchen, N.J.

104. Halen Associates
125 Fifth Ave.
New York, N.Y. 10003

105. Hamamatsu TV Co., Ltd.
c/o Kinsho-Mataichi Corp.
80 Pine St.
New York, N.Y. 10005

106. Hamway Import Co.
40 West 29th St.
New York, N.Y. 10001

107. Harlie Transistor Products
393 Sagamore Ave.
Mineola, L.I., N.Y.

108. Haskel Howard Co.
21 Hazelton Rd.
Yonkers, N.Y.

109. Heritage Int'l Trading Co.
1330 Stuyvesant Ave.
Union, N.J. 07083

110. Hitachi Maxell, Ltd.
501 Fifth Ave.
New York, N.Y. 10005

111. Hitachi New York Ltd.
333 North Michigan Ave.
Chicago, Ill. 60601

112. Hitachi Sales Corp. of America
48-50 34th St.
Long Island City, N.Y. 11101

113. Hokuyo Musen Co., Ltd.
80-26 138th St.
Kew Gardens, N.Y.

114. ITT Distributor Products
250 Broadway
New York, N.Y.

115. Ikegami Electronics Industries Inc. of New York
35-27 31st St.
Long Island City, N.Y. 11106

116. Imperial Import Co.
1199 Broadway
New York, N.Y. 10001

117. Impex Electronics
213 South Robertson Blvd.
Beverly Hills, Calif.

118. Industrial Suppliers
755 Folsom St.
San Francisco, Calif. 94107

119. Inland Trading Co.
111 Hackensack Ave.
New Jersey

120. Intermart Corp.
147 West 42nd St.
New York, N.Y.

121. International Importers
2242 South Western Ave.
Chicago, Ill. 60608

122. International Transistor
1206 South Maple
Los Angeles, Calif.

123. JFD Electronics Corp.
62nd St. at 15th Ave.
Brooklyn, N.Y.

124. J.J.J. Merchandise
15 West 26th St.
New York, N.Y. 10010

125. JVC America, Inc.
50-35 56th Rd.
Maspeth, N.Y.

126. Jeolco (USA) Inc.
477 Riverside Ave.
Medford, Mass. 02155

127. KCK Co., Ltd.
528 West Wellington Ave.
Chicago, Ill. 60657

128. Kanematsu New York
One Whitehall St.
New York, N.Y.

129. Katone Corp.
37 West 28th St.
New York, N.Y.

130. Kay Jewelers
1328 New York Ave., NW
Washington, D.C. 20005

131. Kaysons International, Ltd.
250 West 57th St.
New York, N.Y.

132. Kent Overseas Inc.
38 West 33rd St.
New York, N.Y.

133. Kenwood Corp.
69-41 Calamus Ave.
Woodside, N.Y.

134. Kowa American Corp.
276 Fifth Ave.
New York, N.Y.

135. Koyo International Inc. of America
330 Madison Ave.
New York, N.Y. 10017

136. Kyocera International Inc.
510 South Mathilda Ave.
Sunnyvale, Calif. 94086

137. Lafayette Radio & Electronics
111 Jericho Turnpike
Syosset, L.I., N.Y.

138. Leader Instrument Corp.
24-20 Jackson Ave.
Long Island City, N.Y. 11101

139. Lion Electronics Corp.
194 South 8th St.
Brooklyn, N.Y.

140. Lloyd's Electronics Corp.
59 North Fifth St.
Saddlebrook, N.J. 07662

141. Lloyd's Electronics of Calif., Inc.
6651 East 26th St.
City of Commerce, Calif. 90022

142. Longines Symphonette
200 Myrtle Ave.
Larchmont, L.I., N.Y.

143. Lucky International
1155 Broadway
New York, N.Y. 10010

144. Luxor International
39 West 29th St.
New York, N.Y.

145. Lynn Stewart Co.
439 East Illinois St.
Chicago, Ill. 60611

146. MYM Trans-World Corp.
1165 Broadway
New York, N.Y.

147. Macy's Department Store
Herald Square
New York, N.Y. 10001

148. Magnavox Co.
270 Park Ave.
New York, N.Y.

149. Major Electronics Corp.
649 39th St.
Brooklyn, N.Y.

150. Manhattan Novelty Co.
263 Canal St.
New York, N.Y. 10013

151. Mar-Lin Enterprises
1472 Broadway
New York, N.Y.

152. Martel Electronic Sales
1199 Broadway
New York, N.Y. 10001

153. Marvel International
30 East 42nd St.
New York, N.Y.

154. Mason Camera Corp.
1141 Broadway
New York, N.Y. 10001

155. Mastercraft Electronic Corp.
1115 Broadway
New York, N.Y. 10010

156. Masterwork Audio Products
1080 Graffle Rd.
Hawthorne, N.J. 07506

157. Matsushita Electric Corp. of America
200 Park Ave.
New York, N.Y. 10017

158. Mercury Record Corp.
35 East Wacker Dr.
Chicago, Ill.

159. Metasco
401 Fifth Ave.
New York, N.Y. 10016

160. Metric TV Parts Repair Center
65 Lexington Ave.
Passaic, N.J.

161. Metro Wholesale Corp.
53 West 43rd St.
New York, N.Y. 10036

162. Midland International Corp.
1909 Vernon St.
North Kansas City, Mo. 64116

163. Miharu Shoji Co., Ltd.
P. O. Box 4
Ellenville, N.Y. 12428

164. Mikado Electronics Corp.
34 Dore St.
San Francisco, Calif.

165. Mitsubishi Electric Corp.
119 East Lake St.
Prudential Plaza
Chicago, Ill. 60601

166. Mitsumi Electronics Corp.
11 Broadway
New York, N.Y. 10004

167. Monarch Electronics Corp.
7035 Laurel Canyon Blvd.
North Hollywood, Calif. 91605

168. Montgomery Ward
619 West Chicago Ave.
Chicago, Ill.

169. Morse Electron Products
9200 Atlantic Ave.
Ozone Park, N.Y. 11416

170. Murata Corp. of America
2 Westchester Plaza
Elmsford, N.Y. 10523

171. NGK Spark Plugs (USA) Inc.
4010 Sawtelle Blvd.
Los Angeles, Calif. 90066

172. Nakamichi Research (USA) Inc.
130 Woodbury Rd.
Woodbury, N.Y. 11797

173. Nason Trading Co.
230 Fifth Ave.
New York, N.Y.

174. National Electronics
38-20 SE 8th St.
Miami, Fla.

175. National Silver Co.
241 Fifth Ave.
New York, N.Y.

176. Net Electronics
8315 East Firestone Blvd.
Downey, Calif. 90241

177. New York Merchandise Co.
32 West 23rd St.
New York, N.Y. 10010

178. New York Transistor Co.
New Jersey

179. Nichicon Capacitor, Ltd.
3941 North Pine Grove Ave.
Chicago, Ill. 60613

180. Nichimen Co.
60 Broad St.
New York, N.Y.

181. Nippon Chemical Condenser Co., Ltd.
86-16 60th Ave.
Rego Park, N.Y. 11373

182. Nippon Columbia Corp. of America
6 East 43rd St.
New York, N.Y. 10017

183. Nippon Electric New York, Inc.
200 Park Ave.
New York, N.Y. 10017

184. Noam Electronics Corp.
118-21 Queens Blvd.
Forest Hills, N.Y. 11375

185. North American Foreign Trading Co.
1115 Broadway
New York, N.Y. 10010

186. North American Philips Co., Inc.
100 East 42nd St.
New York, N.Y. 10017

more . . .

Importer/Distributor List, continued

187. NuVox Electronics
150 Fifth Ave.
New York, N.Y. 10011

188. Oki Electric Industry Co., Ltd.
202 East 44th St.
New York, N.Y. 10017

189. Olson Electronics, Inc.
260 South Forge St.
Akron, Ohio 44308

190. Olympic Radio & TV
34-01 38th Ave.
Long Island City, N.Y.

191. Omron Tateisi Electronics Co.
166 Forbes Rd.
Braintree, Mass. 02184

192. Orion Electric Co.
1199 Broadway
New York, N.Y.

193. Osaka Onkyo Co., Ltd.
230 East 44th St.
New York, N.Y. 10017

194. Pacific Import Co.
37 West 23rd St.
New York, N.Y.

195. Panasonic Repair
43-20 24th St.
Long Island City, N.Y.

196. Peerless Telerad, Inc.
162 Fifth Ave.
New York, N.Y. 10010

197. Pengo Traders
234 Fifth Ave.
New York, N.Y.

198. J. C. Penney Co., Inc.
1301 Ave. of the Americas
New York, N.Y. 10019

199. Petely Enterprises
441 Lexington Ave.
New York, N.Y.

200. Pioneer Electronics (USA) Corp.
140 Smith St.
Farmingdale, L.I., N.Y. 11735

201. Ponder & Best Inc.
58-20 Broadway
Woodside, N.Y.

202. Radio Shack Corp.
730 Commonwealth Ave.
Boston, Mass. 02215

203. Ramson Trading Co.
1185 Broadway
New York, N.Y.

204. Rand Associates
1270 Broadway
New York, N.Y.

205. Realtone Electronics Corp.
34 Exchange Place
Jersey City, N.J. 07302

206. Repair Center
404 Jericho Turnpike
Syosset, N.Y.

207. Roberts Electronics, Inc.
5922 Bowcroft Ave.
Los Angeles, Calif. 90016

208. Ross Electronics
2834 South Lock St.
Chicago, Ill.

209. The Sampson Co.
2244 South Western Ave.
Chicago, Ill.

210. San-ei Instrument Co., Ltd.
Canterbury House, Apt. D-15
15 Canterbury Road
Great Neck, N.Y. 11021

211. Sans & Streiffe, Inc.
8400 Brookfield Ave.
Brookfield, Ill. 60513

212. Sansui Electronics Corp.
32-17 61st St.
Woodside, N.Y. 11377

213. Sanyo Electric, Inc.
221 North LaSalle St.
Chicago, Ill. 60601

214. Selectron International Co., Inc.
4215 West 45th St.
Chicago, Ill.

215. Sharp Electronics Corp.
178 Commerce Rd.
Carlstadt, N.J. 07072

216. Sheraton Electronics Co., Inc.
401 Broadway
New York, N.Y.

217. Shibaden Corp. of America
58-25 Brooklyn Queens Expwy.
Woodside, N.Y. 11377

218. Shimadzu Seisakusho Ltd.
c/o Ataka America Inc.
633 Third Ave.
New York, N.Y. 10017

219. Shin-Shirasuna Electric Corp.
60 Broad St.
New York, N.Y. 10004

220. Showa Musen Kogyo Co., Ltd.
c/o Kanematsu-Gosho (USA) Inc.
One Whitehall St.
New York, N.Y. 10004

221. Singer Consumer Products
30 Rockefeller Plaza
Room 6228
New York, N.Y. 10020

222. Son Lee Electronics
1227 Broadway
New York, N.Y.

223. Sony Corp. of America
47-47 Van Dam St.
Long Island City, N.Y. 11101

224. Spiegel, Inc.
1061 West 35th St.
Chicago, Ill. 60609

225. Sportmaster Radio
2570 Devon Ave.
Des Plaines, Ill.

226. Standard Radio Corp.
60-09 39th Ave.
Woodside, N.Y. 11377

227. Standard Radio Corp.
1934 South Cootner Ave.
Los Angeles, Calif. 90025

228. Stanford International
569 Laurel St.
San Carlos, Calif. 94070

229. Sterling Hi-Fidelity, Inc.
24-40 40th Ave.
Long Island City, N.Y. 11101

230. Summit International
1140 Broadway
New York, N.Y. 10001

231. Superex Electronics
4 Radford Pl.
Yonkers, N.Y.

232. Symphonic Radio & Electronics Corp.
470 Park Ave. S.
New York, N.Y. 10016

233. TDK Electronics Corp.
82 Wall St.
New York, N.Y. 10005

234. Takt Denki New York
1170 Broadway
New York, N.Y. 10001

235. Tamradio Co., Ltd.
241-20 Northern Blvd.
Douglaston, N.Y. 11363

236. Tamura Electric Works Ltd.
437 Fifth Ave.
New York, N.Y. 10016

237. Tandberg of America
8 Third Ave.
Pelham, N.Y. 10803

238. Teac Corp. of America
1547 18th St.
Santa Monica, Calif. 90404

239. Telefunken Sales Corp.
South St./Roosevelt Field
Garden City, L.I., N.Y. 11530

240. Tele-Tone Co., Inc.
444 South 9th Ave.
Mount Vernon, N.Y.

241. Telmar
2339 South Cotner Ave.
Los Angeles, Calif. 90064

242. Tenna Corp.
19201 Cranwood Pkwy.
Cleveland, Ohio

243. Terra International
3 East 28th St.
New York, N.Y. 10016

244. J. H. Thal Associates
200 Fifth Ave.
New York, N.Y.

245. Alfred Toepfer
One Broadway
New York, N.Y. 10004

246. Tokai Corp. of America
500 Fifth Ave.
New York, N.Y. 10036

247. Toko New York, Inc.
350 Fifth Ave.
New York, N.Y. 10001

248. Tokyo Sansei
1170 Broadway
New York, N.Y. 10001

249. Topp Import & Export, Inc.
40 Whelan Rd.
East Rutherford, N.J.

250. Toshiba America, Inc.
477 Madison Ave.
New York, N.Y. 10022

251. Toyo Radio Corp. of America
1842 B. West 169th St.
Gardena, Calif. 90247

252. Toyomenka, Inc.
2 Broadway
New York, N.Y.

253. Trade Distributors, Inc.
1199 Broadway
New York, N.Y. 10001

254. Trade Unlimited
75-03 Main St.
Flushing, N.Y.

255. Trans-Aire Electronics Corp.
393 Sagamore Ave.
Mineola, N.Y.

256. Trans America Electronic Co., Inc.
6479 North Avondale
Chicago, Ill. 60631

257. Transistor World Corp.
52 Broadway
New York, N.Y.

258. Transworld Industrial Corp.
5204 Hudson Ave.
West New York, N.J.

259. Trio Corp.
212 Fifth Ave.
New York, N.Y.

260. Trio Corp.
(Kenwood Electronics, Inc.)
3700 South Broadway Pl.
Los Angeles, Calif. 90007

261. Tussah Corp.
1412 Broadway
New York, N.Y. 10018

262. Valiant Radio Corp.
380 Second Ave.
New York, N.Y.

263. Vendome Enterprises
212 Fifth Ave.
New York, N.Y.

264. Voca Dictating Machine
274 Madison Ave.
New York, N.Y.

265. Vornado, Inc.
174 Passaic St.
Garfield, N.J. 07026

266. Western Auto Supply
2107 Grand Ave.
Kansas City, Mo. 64108

267. Whitehall Overseas Corp.
1140 Broadway
New York, N.Y.

268. Wilson Import Co.
1157 Broadway
New York, N.Y. 10029

269. World Mark Electronics
663 Dowd Ave.
Elizabeth, N.J.

270. Yamatake-Honeywell Co., Ltd.
c/o Honeywell, Inc.
24-30 Skillman Ave.
Long Island City, N.Y. 11101

271. Yaskawa Electric America, Inc.
100 Bliss Dr.
Oak Brook, Ill. 60521

272. Yewtec Corp.
1995 Palmer Ave.
Larchmont, N.Y. 10538

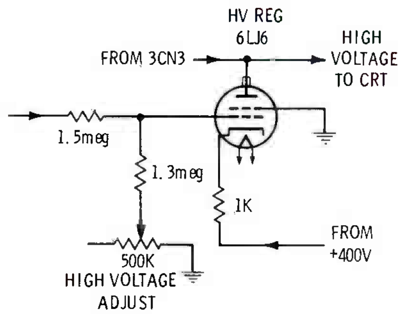
273. York Radio Corp.
15 Empire Blvd.
South Hackensack, N.J. 07606

274. Yutaka Electric Mfg. Co. Ltd.
c/o Marubeni-Iida (America) Inc.
938 Merchandise Mart
Chicago, Ill. 60654

symcure

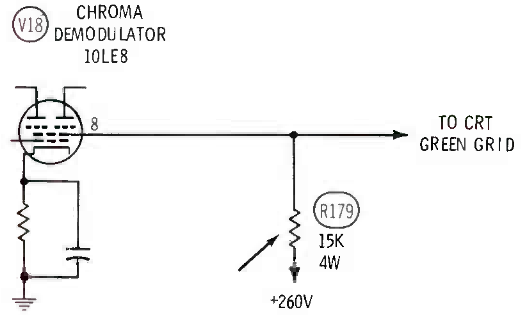
Symptoms and cures compiled from field reports of recurring troubles

Chassis—GE KE
PHOTOFACT—978 POM



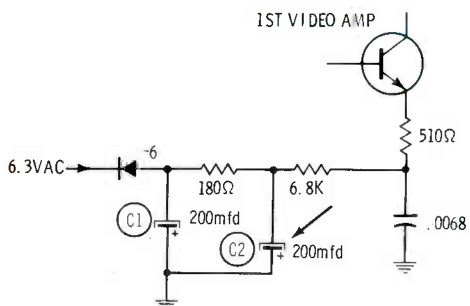
Symptom—Intermittent arcing
Cure—Replace 6LJ6 high-voltage regulator and reset the high voltage to 25KV

Chassis—Olympic CT910
PHOTOFACT—918-1



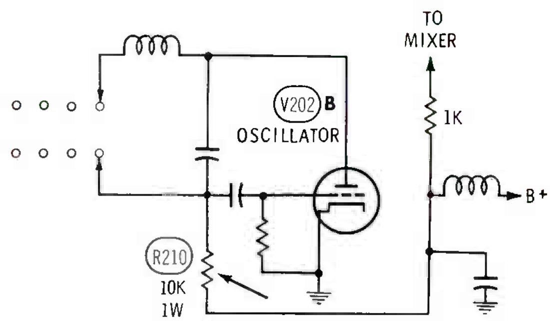
Symptom—Excessive brightness and weak color
Cure—Replace open R179 in screen circuit of V18

Chassis—GE KE
PHOTOFACT—978 POM



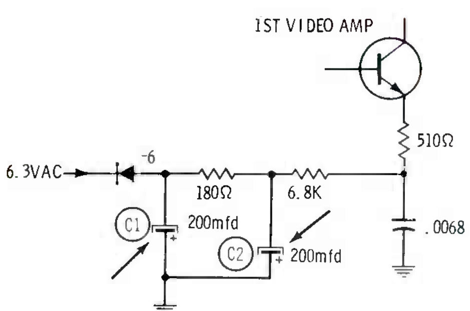
Symptom—No video, no raster
Cure—Replace shorted C2

Chassis—Olympic CT910
PHOTOFACT—918-1



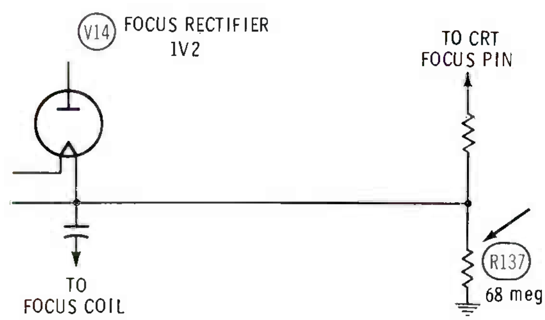
Symptom—Intermittent tuner
Cure—Replace burned R210 and 5GS7 mixer-oscillator tube

Chassis—GE KE
PHOTOFACT—978 POM



Symptom—Hum bar in picture
Cure—replace open C1 or C2

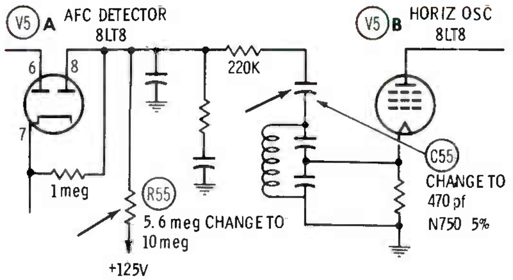
Chassis—Olympic CT910
PHOTOFACT—918-1



Symptom—Little adjustment of focus
Cure—replace open R137

symcure

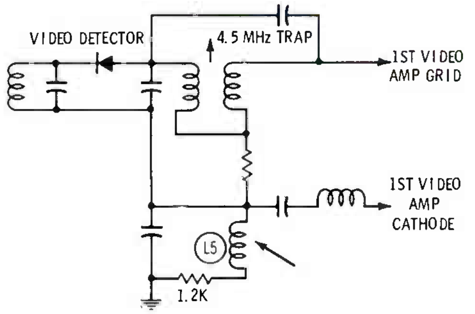
Chassis—GE S and V series
PHOTOFACT—965-1



Symptom—Horizontal oscillator intermittently does not start

Cure—Change R55 to 10 meg and change C55 to 470 pf, N750, 5%

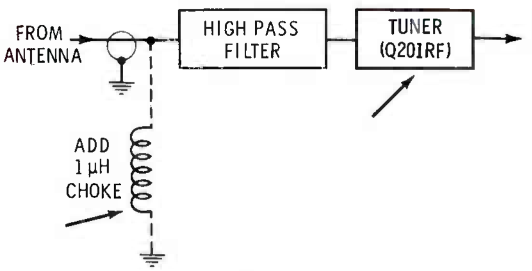
Chassis—RCA CTC24
PHOTOFACT—912-3



Symptom—Overload, smeared picture

Cure—Replace open L5, peaking coil in detector

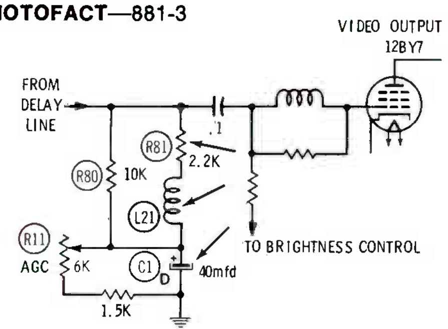
Chassis—Sony TV710U and 720U
PHOTOFACT—none



Symptom—RF transistor shorted

Cure—replace transistor (Q201) and add a 1-millihenry choke from antenna to chassis ground

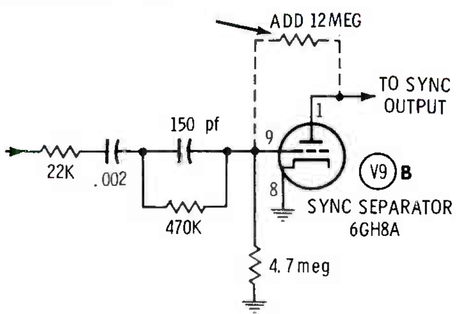
Chassis—RCA CTC21
PHOTOFACT—881-3



Symptom—Ghosts—not antenna, delay line or tunable

Cure—Replace open R81, L21 or C1D

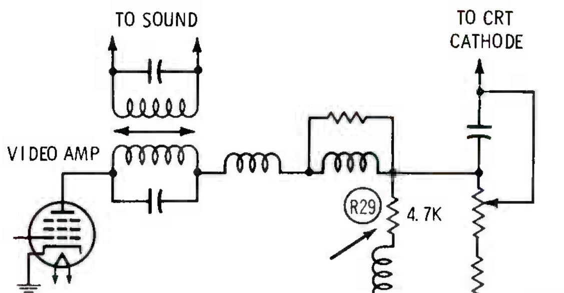
Chassis—Magnavox T924
PHOTOFACT—956-2



Symptom—Horizontal "lock out" and critical locking

Cure—Add a 12 meg-ohm resistor from pin 1 to pin 9 of V9B, the sync separator tube

Chassis—Olympic NDP
PHOTOFACT—840-2



Symptom—Picture smear and pulling

Cure—Replace R29 in video amplifier circuit ▲

photofact bulletin

PHOTOFACT BULLETIN lists new PHOTOFACT coverage issued during the last two months for new TV. This is another way ELECTRONIC SERVICING brings you the very latest facts you need to keep fully informed between regular issues of PHOTOFACT Index Supplements issued in March, June, and September. PHOTOFACT folders are available through local parts distributors.

ADMIRAL

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Chassis T7H2-1A, T9H1-1A 1062-1

AMBASSADOR

2907A 1065-1

CARDINAL

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Chassis AS-8090, 8091 .... 1065-2-A

CATALINA

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CLOVIS

122-1008 1062-2
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Chassis KD 1061-3

MAGNAVOX (Color TV)
Chassis T931-01-BA/-CA thru T931-19-BA/-CA, T931-23-BA/-CA, T931-25-BA/-CA, T931-26-BA/-CA, T931-27-AA/-BA/-CA thru T931-30-AA/-BA/-CA 1055-3

MAGNAVOX
Chassis T915-01-DA/-EB, T915-02-AB/-CA/-DA/-EB, T915-04-BA/-CA/-DA, T915-05-CA/-DA/-EB, T915-06-CA/-DA/-EB, T915-07-DA, T915-14-FC, T915-15-FC .. 1059-3
Chassis T919-01-CB, T919-02-CB, T919-04-CB, T919-07-CB, T919-08-CB, T919-09-CB, T919-10-BB/-CB, T919-16-CB, T919-18-CB .. 1065-3

PHILCO
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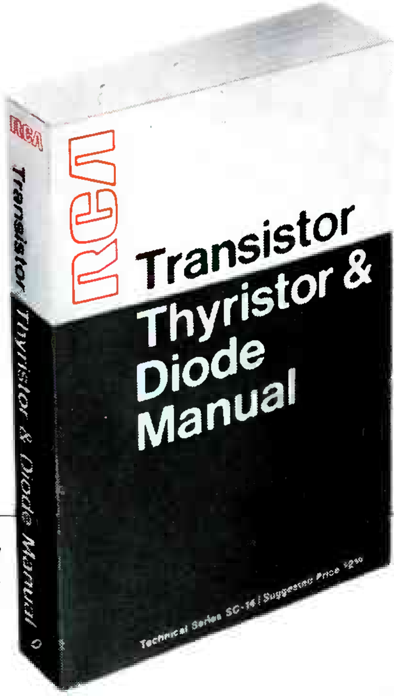
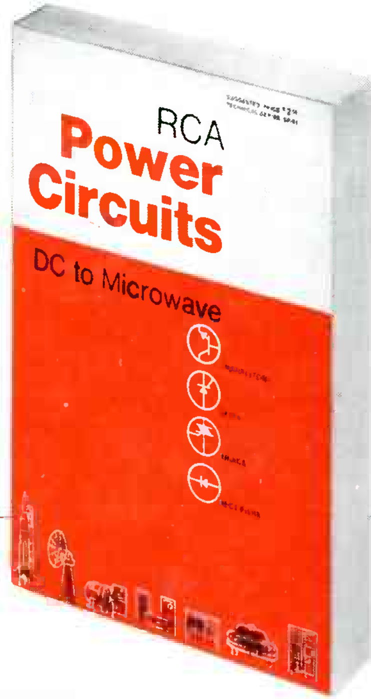
solid state...up to date





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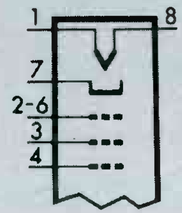
RCA

Circle 26 on literature card

Protection—Banded
Deflection—114°
Filament—6.3V @ .45A
Grid 2—150V

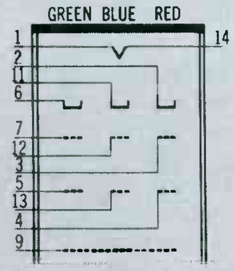
20AHP4



8HR

Protection—Banded
Deflection—90°
Filament—6.3V @ 1.35A
Grid 2—400V

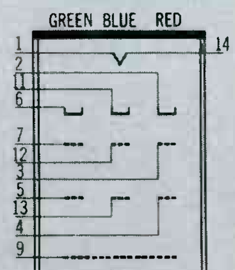
22AHP22



14BE

Protection—Bonded
Deflection—90°
Filament—6.3V @ 1.35A
Grid 2—400V

25GP22A

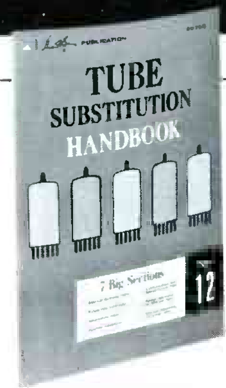


14BE

d

Electronic Servicing Tube Substitution Supplement

This Supplement has been designed to provide you with the latest up-to-date information on new tubes. The format allows maximum use during a house call or at the bench.



REMOVE THIS SUPPLEMENT FROM **Electronic Servicing** and put it in the back of your **TUBE SUBSTITUTION HANDBOOK**

direct substitutes

Included are the older tubes that will substitute directly for the new tubes. This information supplements the sections in the Tube Substitution Handbook for American Receiving Tubes and Picture Tubes.

basing diagrams

The basing diagram for each new tube will help you in the servicing of new receivers when service literature is not available.

typical characteristics

The typical, or average, characteristics of each new tube can be of great help when troubleshooting new circuits.

easy reference

The direct substitution list will be cumulative each month. Thus, only the latest edition need be carried in the Tube Substitution Handbook.

Direct Substitutions

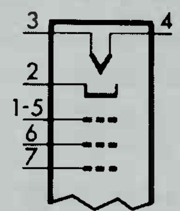
To Replace	Use	To Replace	Use
5MQ8	*	16LU8A	16LU8
6AG9	6AL9	17FCP4	*
6AK10	*	18AJ10	*
6AL9	6AG9	20AHP4	*
6MQ8	*	22AHP22	*
8AL9	*	25GP22A	*
8KR8	*	31AL10	*
8LS6	*	32HQ7	*
9AK10	*	33HE7	*
10ASP4	*	12DEP4	*
10LY8	*	12DHP4	*
12DKP4	*	19GEP4	*
15ACP22	*	19HNP22	*
16BX11	*	22TP4	*
16DCP4	*	22ZP4	*
16LU8	16LU8A	25ALP22	*

*No substitution at present time.
Twelfth edition of Tube Substitution Handbook now available at your distributor.

General Specifications

10ASP4

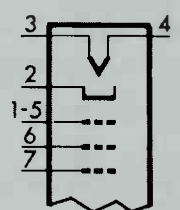
Protection—Banded
Deflection—90°
Filament—6.3V @ .45A
Grid 2—100V
Neck diam.—0.787"



7GR

12DKP4

Protection—Banded
Deflection—110°
Filament—6.3V @ .45A—11 sec
Grid 2—140V

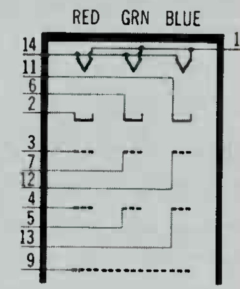


7GR

b

15ACP22

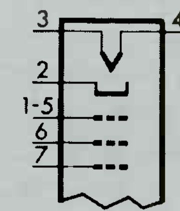
Protection—Filled rim.
Deflection—90°
Filament—6.3V @ .9A
Grid 2—200V



14BH

16DCP4

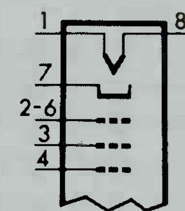
Protection—Banded
Deflection—100°
Filament—6.3V @ .45A
Grid 2—140V
Neck diam.—0.840



7GR

17FCP4

Protection—Filled rim.
Deflection—114°
Filament—6.3V @ .45A—11 sec
Grid 2—400V



8HR

c

troubleshooter

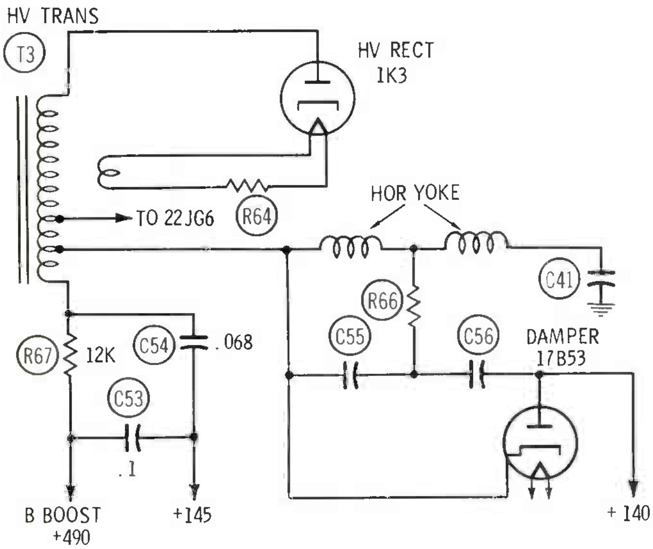
High Voltage Failure

On a Sears Silvertone Model M2737U b-w TV (PHOTOFACT 723–3), I have checked every part in the horizontal circuit and find that all are okay, yet occasionally the high voltage fails. After I disconnect C41 and reconnect it, the raster appears. The flyback and all horizontal tubes have been substituted, but there is no change. What is most likely the trouble?

Herman Porter
Allen, Kentucky

C41 is between the yoke and ground, so it is there to block DC only. Disconnecting it is the same as opening the yoke. I assume you have substituted the capacitor to make sure it is good.

One of the possibilities is that the horizontal sweep is weak at all times. This would supply insufficient filament voltage to the 1K3 high-voltage rectifier, and a small drop in line voltage would reduce the filament voltage to it so that the tube would not operate. I would suggest that you check the B+ at point 23 (normally +140 volts) or at the cathode of X1 rectifier (normally +145). Also check the B boost voltage at point 44 (normally +490). Use this boost voltage as an indicator of the condition of the horizontal circuitry; for if it is low, the high voltage also will be low.



Have you substituted the yoke yet? R66, C55 and C56 can be checked easily by disconnecting them at the point where they are wired together. The set should have more high voltage, but less width with them disconnected. If any one of these capacitors is shorted or open, the 1K resistor (R66) will burn up. Has R64, the 3.9-ohm filament resistor for the 1K3, been checked yet? Also, R65 might be open or intermittent. These two resistors should be suspected if the boost voltage is normal and does not decrease when the high voltage drops to zero. ▲

Test equipment applications and techniques

Using B & K's new Model 415 Sweep/Marker Generator to align the Zenith 14A9C51 color chassis. / by Carl Babcoke

One of the most talked about pieces of test equipment these past few months has been the B&K Model 415 Sweep/Marker Generator. This generator incorporates the functions of sweep, marker, marker-adder and bias supplies in one unit. We had been awaiting eagerly the arrival of one of these generators so we could use it in actual shop TV alignment. After receiving the generator, we immediately applied it to the function for which it was designed, TV alignment—in this case, a Zenith 14A9C51 color chassis. The many features we found in this instrument are listed in the following paragraphs, along with the step-by-step procedure for aligning the Zenith 14A9C51 chassis.

Features of the B&K Model 415 Sweep/Marker Generator

• Convenient groupings of the front panel controls according to usage, as shown in Fig. 1.

• These outputs are selected by the function switch: video or chroma sweep (depending on the setting of the chroma on/off switch), IF sweep for the 40-MHz band, markers (choice of ten crystal-controlled markers), modulated markers (the same markers modulated by 400 Hz), channel 4 sweep, channel 10 sweep and 10.7-MHz sweep for FM alignment.

• Video, chroma, IF and 10.7-MHz sweep functions have a dial for adjusting the center frequency.

• A SWEEP WIDTH control regulates the amount of frequency deviation.

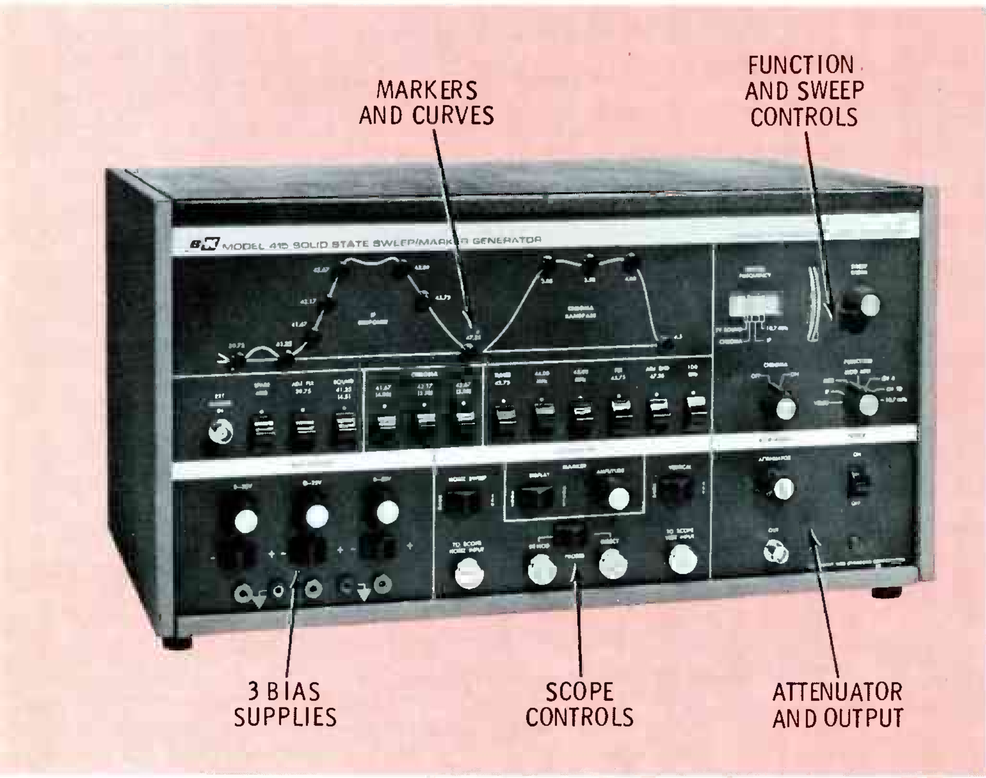


Fig. 1 Front panel of the B&K Model 415 Sweep/Marker Generator is divided into five sections according to the related functions.

• The CHROMA switch changes the equipment to the video-sweep modulation (VSM) mode of operation.

• 60 dB of signal attenuation is accomplished by changing the bias on a dual-gate Field-Effect Transistor (FET).

• The universal output-termination pad uses a switch to select either unbalanced 75-ohm or balanced 300-ohm impedance (see Fig. 2A).

• Two curves, one IF and one chroma, are printed on the front panel, with most of the marker positions indicated by red neon bulbs that light when the corresponding marker is switched on.

• Ten crystal-controlled markers are provided. They can be used in any combination from none to all on at one time. There is an identical spare marker circuit that can be activated by plugging in a third-overtone crystal (any frequency between 35 MHz and 50 MHz) and tuning one coil. Or this circuit can be changed to a variable-frequency marker. In addition, a jack is provided for connection of an external generator to provide any other desired marker frequency.

• A crystal-controlled 10.7-MHz marker is turned on automatically when 10.7-MHz sweep is selected by the FUNCTION switch.

• All markers may be seen vertically in the conventional way, or the DISPLAY switch can be slid to the HORIZONTAL position to tilt the markers horizontally for better accuracy on steep-sided curves (Fig. 3).

• The 100-KHz switch adds a whole series of smaller markers spaced 100 KHz apart on both sides of any IF marker selected. These 100-KHz markers decrease in amplitude as they become farther from the IF marker, but about 10 or 12 can be seen plainly if the marker amplitude is increased. Both the reg-

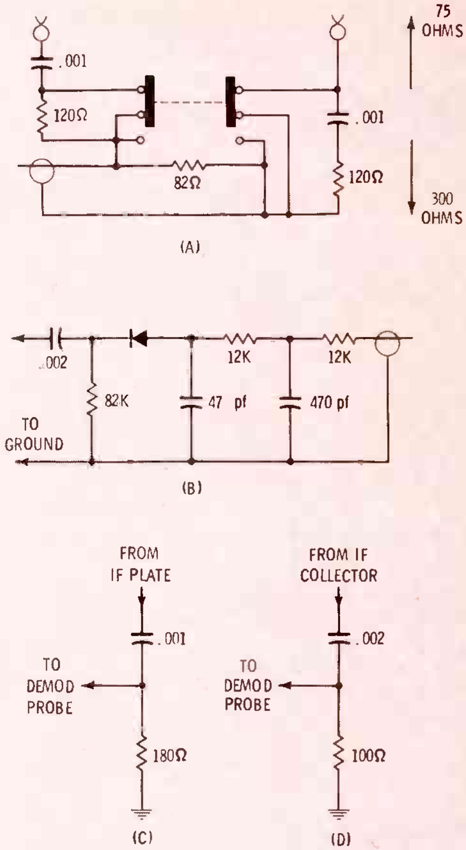


Fig. 2 A) Schematic of the output cable anc... ...hing pads. B) Universal de-... modulator probe circuit. C) For link alignment... ...c circuits, use this load... and the demodulator probe. D) Use this load... ...dulator probe for aligning the link circuit in a transistorized IF recei...

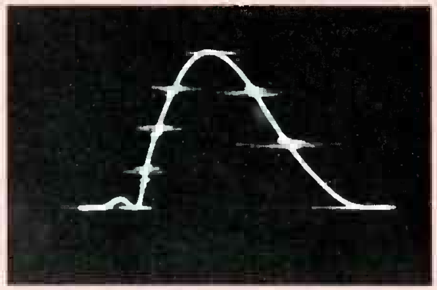


Fig. 3 H... produced... formation is... zontal sweep... stead of the... adding the ma... tical input of th...

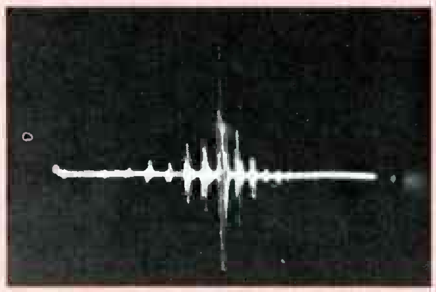


Fig. 4 Groups of mar... KHz apart can be added... of the markers.

ular IF markers and the 10.7-MHz FM marker can have these marker groups, but they are much weaker on the 40-MHz markers. The 100-KHz markers for FM alignment are pictured in Fig. 4.

• Two probes are included with the generator for connection to the TV receiver. One has a 10K resistor (to sharpen the markers) in series with the ungrounded lead, as specified in many alignment procedures. The other is a universal demodulator probe (see Fig. 2B) for video or chroma measurements. With the addition of an IF load block for tube receivers (Fig. 2C) or for transistor IF's (Fig. 2D), the same demodulator can be used for link or individual IF stage alignment.

• It is not necessary to unscrew one probe cable connection to connect the other; both are connected to the generator at all times, and either can be selected by the PROBES switch.

• A full set of cables and leads is provided, including both microphone connector and banana plug types for scope connections.

• Polarity switches are provided to reverse the phases of both horizontal and vertical sweep applied to the scope. The vertical switch is used to produce an upright curve, regardless of the polarity of the detector circuit used in the receiver or the demodulator probe. A horizontal polarity switch is desirable so that the high frequencies are always displayed on the right side of the scope waveform. This horizontal reversal is done automatically when the CHROMA switch is turned to the ON position for VSM operation.

• Amplitude of the signal sent to the vertical amplifier in the scope is the same as that coming through the probes. If the alignment procedure specifies a certain peak-to-peak amplitude, adjust the ATTENUATOR control on the generator until this reading is obtained on the calibrated scope.

• To avoid the extra work of disabling the horizontal sweep circuit in the TV receiver during alignment, the generator uses a bridged "T" null filter to eliminate any 15,750-Hz horizontal sweep pulses from appearing on the scope waveform.

• To compensate for scopes that have a falling low-frequency response, an adjustable low-frequency boost circuit is used to avoid any tilting of the response curve. As we have pointed out before, the high-frequency response of a scope is not critical, but the low-frequency response is important when viewing alignment curves (see Fig. 5).

• The internal oscillator that supplies horizontal sweep to the scope is synched to the 60-Hz line. Horizontal deflection is not a sine wave, as is used in some other brands of alignment equipment. Instead, a sawtooth having an extremely fast retrace time is used. The retrace does not need to be blanked, and no base line is seen with the alignment waveforms.

• 32 transistors, 20 diodes and 5 FET's are employed in this all-solid-state generator. All power supply voltages are regulated.

• Two 0-25 volt and one 0-50 volt variable voltage sources are provided for AGC bias and general clamping functions. Each of the three voltage sources has a variable control and a polarity switch. Each polarity switch selects voltage from an internal positive or negative supply; there is no voltage inversion by internal cross-connecting of bias leads. Therefore, one control can have negative output; at the same time the other can have a positive output voltage.

• A 400-Hz modulated 4.5-MHz signal for trap adjustment or sound alignment can be obtained by turning the FUNCTION switch to MODULATED MARKERS and selecting both the 41.25-MHz marker and the 45.75-MHz marker.

• Frequencies of crystal-controlled accuracy for other needs, such as radio alignment, can be generated by beat-frequency action between markers. For example, you can turn the FUNCTION switch to MARKERS and turn on the 41.67-MHz and 42.67-MHz markers to obtain a 1-MHz difference frequency at the output cable. Modulation can be added by turning the FUNCTION swtich to MODULATED MARKERS.

• A meter and an oscilloscope are the only other major items of equipment necessary for complete alignment of b-w or color TV receivers.

Marker-Adder Characteristics

Markers that are generated without a marker-added circuit are created when a fixed-frequency marker signal is crossed by a varying-frequency sweep signal. A beat-frequency is formed by the difference between these two frequencies; the nearer they are in frequency, the lower the frequency of the beat signal. A low-pass filter must be used between the receiver and the scope

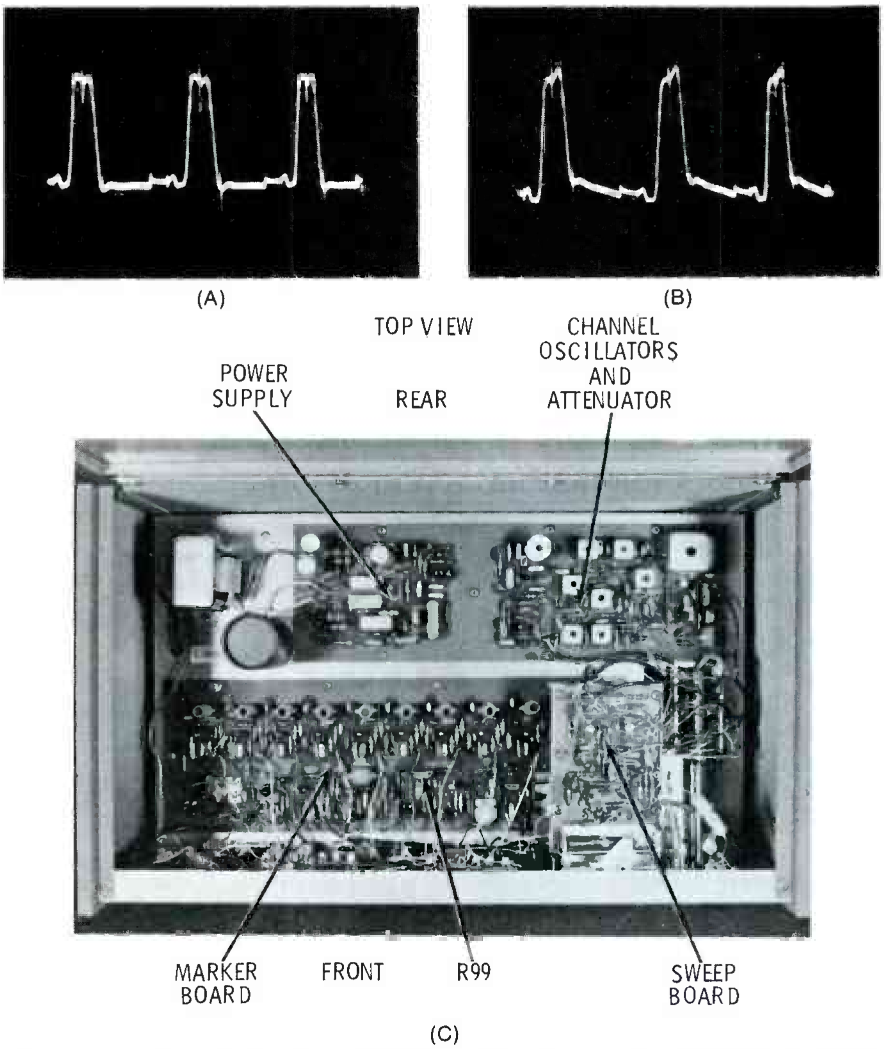


Fig. 5 A) The flat base line shows that this scope has good low-frequency response. B) Overcompensation caused by incorrect adjustment of R99 tilts both the curve and the base line. Poor low-frequency response would tilt the curve and base line the other way. C) Location of R99, the low-frequency compensation control. To adjust this correction for your scope, use the internal horizontal sweep of the scope to obtain two or more curves. Adjust R99 until the base line between the curves is reasonably flat, as shown in Fig. 5A.

to remove all but the very low frequencies so that the marker pip will be narrow. Since both sweep and marker signals are fed through the receiver to the scope, a strong marker may distort the sweep curve. Also, the amplitude of the marker depends on the amplitudes of **both** the sweep and marker signals; therefore, the size of the marker changes according to its position on the curve. Often a lot of delicate balancing of signal levels must be done to avoid erroneous and misleading results.

The marker generated by a marker-adder unit is still created by the beat-frequency process, but **samples** of the sweep and marker signals are used. Such a marker is mixed with the sweep curve coming from the receiver, and both go to the scope. Only the sweep signal passes through the receiver; the marker is added later. For this reason, they are often called post-injected markers. In all such systems, the signal from the receiver does not go directly to the scope, but to the marker-adder circuit where the marker is added and then both go to the scope.

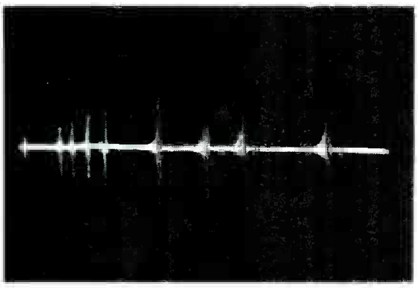


Fig. 6 Markers may be seen without a receiver. All the IF markers from 39.75-MHz to 47.25-MHz are shown.

One unexpected result of the marker-adder method is the possibility of obtaining markers **without** a curve; thus, we can have markers without a receiver, as shown in Fig. 6. The marker-adder circuit is an integral part of the B&K Model 415. It works automatically on all sweep functions. If you don't want markers, just switch them off or turn down completely the MARKER AMPLITUDE control.

More tips about using this generator are included in the step-by-step alignment procedure.

Zenith 14A9C51 Alignment Procedure

Complete alignment can be done without removing the chassis if the bottom is removed and the high-voltage side of the cabinet is placed down on the bench.

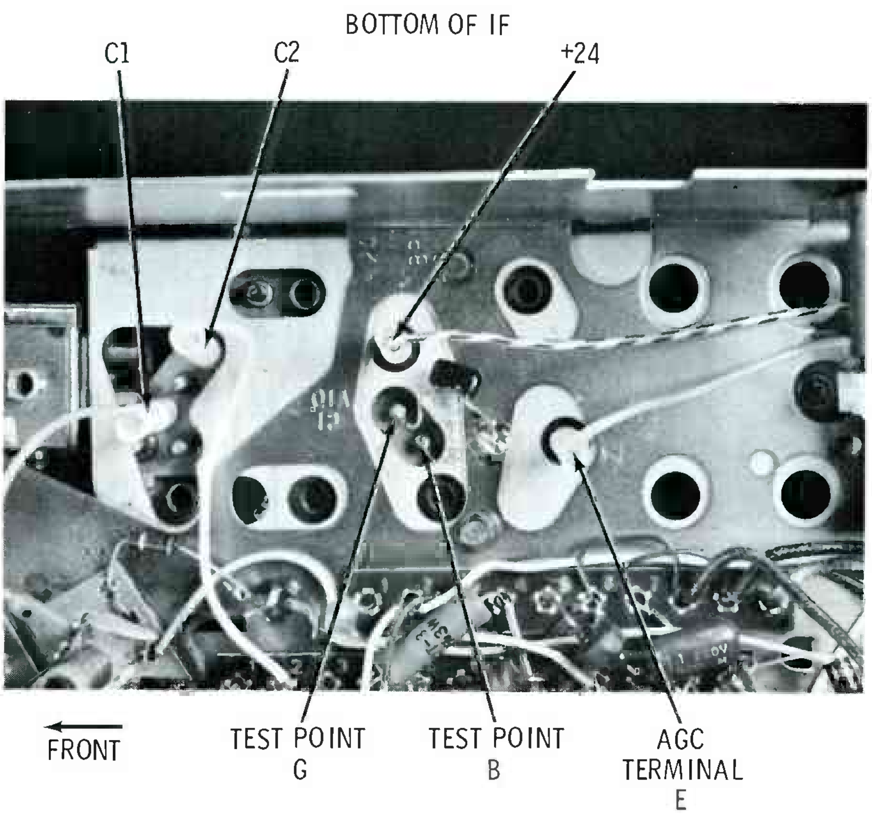


Fig. 7 Location of the AGC terminal and other test points underneath the IF compartment of the receiver.

Precautions

Solid-state components require that extra precautions be taken if we are to avoid accidental component failures. For example, the fixed AGC voltage taken from the Model 415 generator should be attached to the TV chassis while the bias voltage control is turned down to zero and before the receiver is turned on. After the set is turned on and has warmed up, the bias voltage should be increased (while it is monitored by a meter) to the correct amount. This eliminates any chance of damage to the base-emitter junction of the first IF transistor. If there is a possibility that a pad, probe or test lead could become disconnected after being attached to the circuit, the receiver should be turned off while such connections are made secure. This is to avoid the damage to the chassis or test equipment that that would result if a falling lead should contact a critical circuit or one with a dangerous voltage. **Practice safety first!**

Test Equipment Setup

Prepare the Model 415 generator as follows:

1) Turn the CHROMA switch to OFF position
2) Adjust the CENTER FREQUENCY to approximately the position on the dial that is marked "IF"
3) Turn SWEEP WIDTH up to about the ¾ position
4) Rotate the FUNCTION switch to IF
5) Turn the ATTENUATOR control completely down
6) Slide the HORIZONTAL SWEEP switch to NORMAL
7) Move the MARKER DISPLAY switch to VERTICAL
8) Adjust the MARKER AMPLITUDE control up about ⅛
9) Slide the VERTICAL switch to REVERSED (this Zenith has a positive-going video detector)
10) Switch a 0-25 volt BIAS SUPPLY to + with level control turned down
11) Slide all marker switches down (off)
12) Turn on the 41.25-MHz and 47.25-MHz markers by sliding their switches up. Notice if the corresponding light on the IF curve is lit
13) Slide the PROBES switch to DIRECT

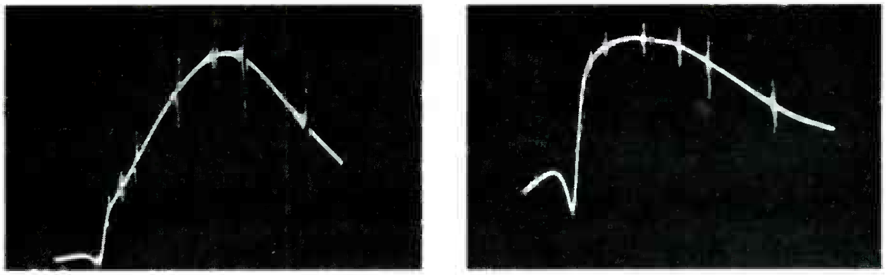


Fig. 8 A) 4th IF transformer curve without the 47-pf capacitor. B) 4th IF transformer curve produced when the 47-pf capacitor is used.

14) Make sure the cables from the generator to the vertical and horizontal inputs on the scope are connected

15) Attach the DEMODULATOR, DIRECT and OUTPUT cables to the generator

16) Set the scope for external sweep and adjust horizontal gain, brightness, focus, etc. as needed

Receiver Setup

Prepare the receiver for alignment as follows:

1) Turn the receiver power and AFT off

2) Rotate the channel selector to channel 13 if either a rotary-switch or a turret tuner is used—if the set uses a Super Gold Video Guard tuner, set it **between** channels

3) Remove the yellow AGC wire from terminal E, as shown in Fig. 7

4) Attach a wire from the previously prepared bias supply to terminal E

5) Connect the direct probe of the generator to test point C1 (video detector)

6) Solder a 47-pf capacitor (use short leads) from test point B to ground

7) Slide the switch on the output-termination pad to the "75-ohm" position, then attach the pad to test point G and ground

8) Turn on the receiver, sweep generator and scope

9) Monitor the AGC bias with a meter while increasing the voltage to +7.5 (the higher the voltage, the less the gain of the first IF transistor)

The receiver and test equipment are now ready for alignment of the 4th IF transformer. Proceed as follows:

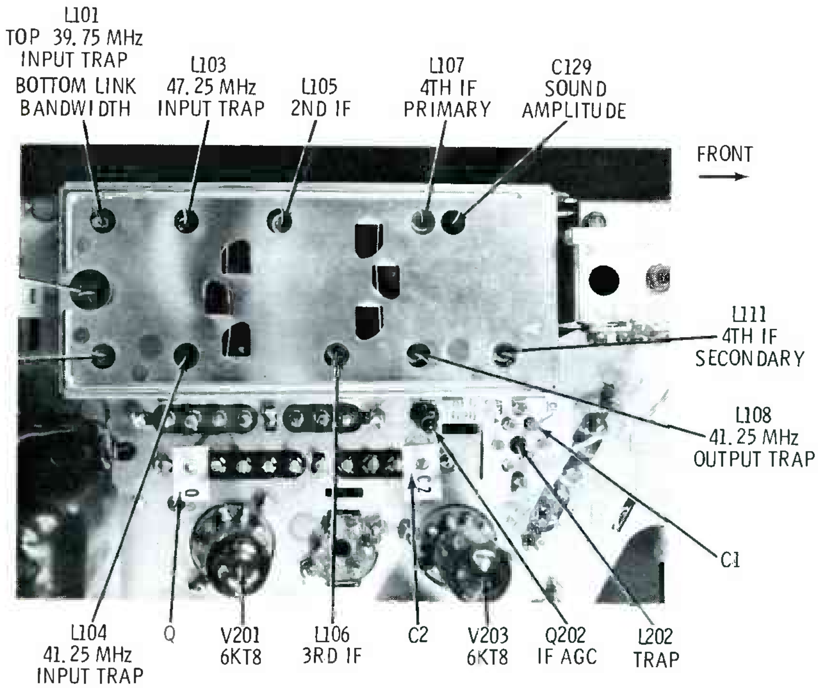


Fig. 9 Location of the IF adjustments and several top-of-the-chassis test points of the receiver.

1) Adjust the RF-IF-Video ATTENUATOR control for 2 volts of peak-to-peak waveform at the scope

2) Alternately adjust the scope's horizontal gain, vertical and horizontal centering, and the SWEEP WIDTH and CENTER FREQUENCY controls of the generator until the curve on the scope is centered and both the 41.25-MHz and 47.25-MHz markers can be seen. The curve should look somewhat like that shown in Fig. 8. Adjust MARKER AMPLITUDE as needed.

NOTE: A 2-volt P-P output signal should not be distorted; if it is, the last IF stage or video detector circuit must be defective. Temporarily increase the ATTENUATOR control and look for any change in waveshape. As a general rule, you can increase the signal until the waveshape becomes distorted, then reduce the generator signal until the curve is about half the height at which distortion occurred.

3) Rotate the FUNCTION switch to MODULATED MARKERS, switch off the 47.25-MHz marker. The curve should be gone.

4) Increase the scope gain to maximum and advance the ATTENUATOR control until 400-Hz sine waves can be seen (they probably will not be locked). Adjust the one core of L108 (the 41.25-MHz output trap) for minimum scope height. See Fig. 9 for the trap and transformer locations.

5) Return the FUNCTION switch to the IF position, and the scope gain and generator ATTENUATOR controls to the previous setting.

6) Turn on 39.75-, 41.25-, 41.67-, 42.17-, 42.75-, 44.0-, 45.0-, 45.75- and 47.25-MHz markers. To identify any marker, momentarily switch it off and the marker should disappear.

7) Adjust L111, the fourth IF transformer secondary, so that the 42.75-MHz and 45.0-MHz markers are the same height from the **bottom** of the curve. Adjust the top core of L107, the fourth IF primary, for maximum curve height at about 44.0 MHz, and L107 bottom core for equal height of the 42.75-MHz and 45.0-MHz markers at about 90%, as shown in Fig. 8B.

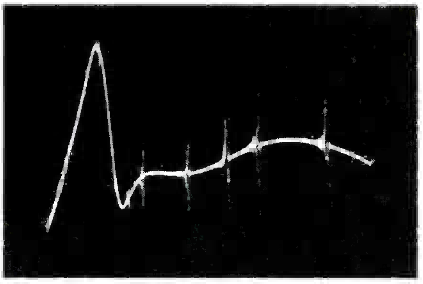


Fig. 10 Typical response curve of the 4th IF viewed at test point C2. 41.25 MHz is the highest point on the curve.

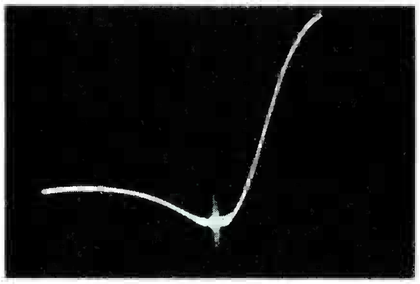


Fig. 11 To align the traps with sweep, expand the curve with the SWEEP WIDTH control on the generator, as shown here.

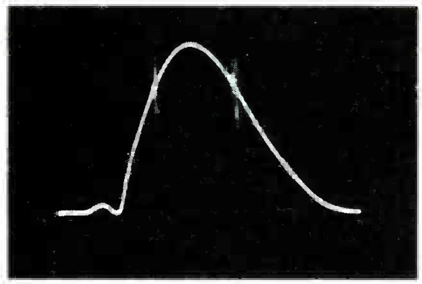


Fig. 12 Adjust L102 to position the 42.75-MHz and 45.0-MHz markers the same distance above the base line.

8) Carefully notice (or measure) the height of the 45.75-MHz part of the curve. Connect the generator's direct probe to test point C2 (pin #7 of V203) and slide the VERTICAL polarity switch to the NORMAL position to invert the trace.

9) Adjust C129 so that the height of the curve at the 45.75-MHz marker is one/half that obtained in the previous step (See Fig. 10).

10) Disconnect the temporary 47-pf capacitor from test point B, connect the generator output pad (still set for 75 ohms) to test point A on the tuner, change the FUNCTION switch to MODULATED MARKER position, adjust the ATTENUATOR to minimum, switch off all markers except 39.75 MHz, and adjust the scope gain to maximum.

11) Adjust the top core of L101 for minimum scope pattern. Advance the ATTENUATOR slightly, if needed to see the trace on the scope.

12) Switch off the 39.75-MHz marker and turn on the 41.25-MHz marker. Adjust the top core of L104 for minimum. Switch off the 41.25-MHz marker and turn on the 47.25-MHz marker. Adjust the top and bottom cores of L103 for minimum.

NOTE: Do NOT use more signal than absolutely necessary. Excessive signal will overload the mixer or IF stages and may cause a false indication so that a minimum adjustment will occur with the traps tuned near the middle of the curve. In an extreme case, an alternate method may be used: Change the equipment to IF sweep, as given in the next step. Reduce the SWEEP WIDTH and adjust the CENTER FREQUENCY to bring the marker for the trap frequency we want to the center of the screen as shown in Fig. 11. Then adjust the trap for a dip in the curve that moves the marker lower on the screen.

13) Move the direct probe back to test point C1, slide the VERTICAL switch to REVERSED, turn the FUNCTION switch to IF and switch on these markers: 39.75-, 41.25-, 42.75-, 45.0- and 45.75-MHz. Decrease the ATTENUATOR until the waveform stops changing in shape, then decrease it still more to make certain there is no overload. Or adjust for 2 volts peak-to-peak as measured on the scope.

14) Adjust the mixer plate coil (on the tuner) for maximum height of the curve at 42.75 MHz. Adjust both the top and bottom cores of L102 (1st IF transformer) for maximum overall amplitude and correct location of the 42.75-MHz and 45.0-MHz markers, as shown in Fig. 12.

15) Adjust the bottom core of L105 (2nd IF transformer) for equal height of the curve at the 42.75-MHz and 45.0-MHz markers.

16) Adjust the one core of L106 (3rd IF coil) for maximum curve height at 45.0 MHz.

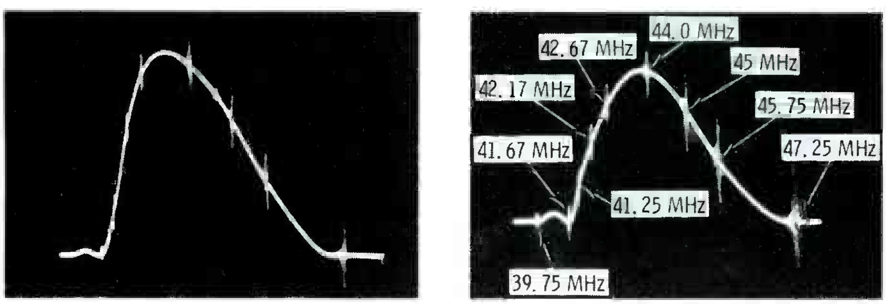
NOTE: Because there is some interaction between traps and transformers, better accuracy will be obtained if steps 10, 11, 12, 13, 14, 15 and 16 are repeated.

17) Adjust the bottom core of L101 (link bandwidth) for correct position of the 41.67-MHz marker at 20% height. It may be necessary to readjust L102 for maximum at 42.75 MHz, then repeat the L101 bottom core adjustment.

18) Connect the direct probe to test point C2 and adjust both cores of L104 (input 41.25-MHz trap) for approximately 24 dB of attenuation. Adjust the vertical gain control on the scope for a 2-inch high waveshape, then increase the vertical gain by a factor of 10. Alternately adjust both cores of L104 so that the valley made by the trap response is 1 to 1½ inches high.

NOTE: I obtained this amount of attenuation in the set I aligned, but could not obtain more.

19) Connect the scope to test point C1 and reduce the AGC bias to about +5 volts. This lower forward bias greatly increases the gain. Decrease the generator output with the ATTENUATOR control until the waveform is no longer distorted.



(A) (B)

Fig. 13 A) The original curve produced by Zenith factory alignment. B) Overall IF curve obtained after re-alignment is much closer to Zenith's specifications.

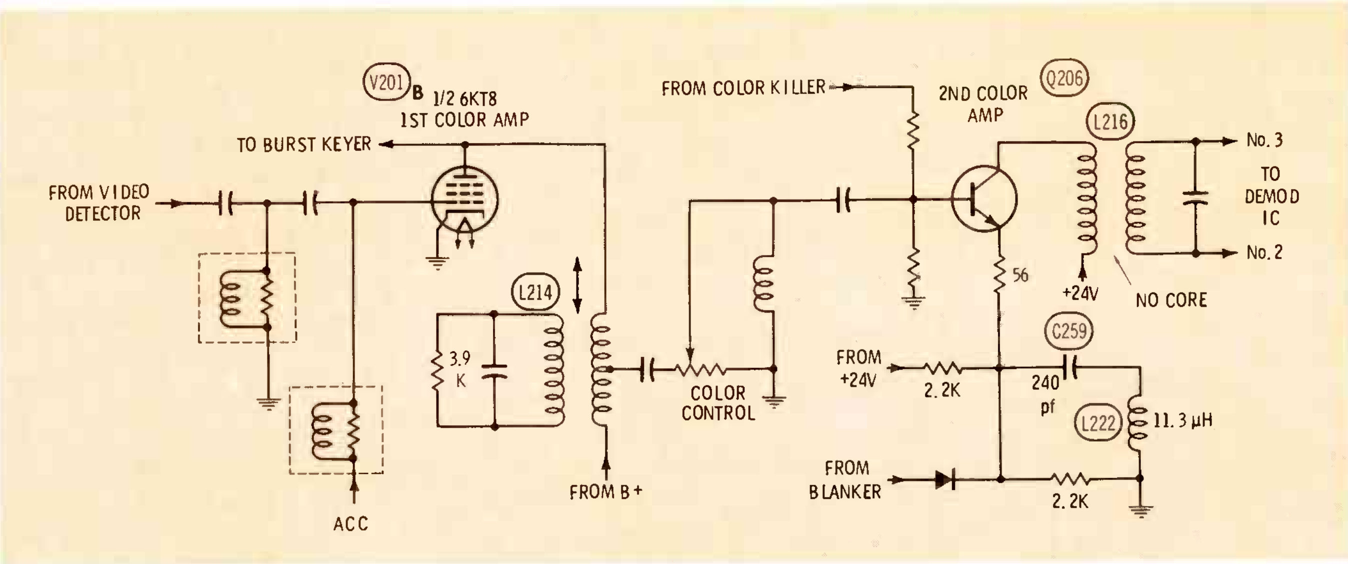


Fig. 14. Simplified schematic of the 14A9C51 Zenith chroma IF amplifiers.

20) Adjust the top core of L105 (2nd IF transformer) for maximum response in the area between the 45.0-MHz and 45.75-MHz markers.

21) Reset the bias to +7.5 volts, increase the ATTENUATOR adjustment to provide approximately 2 volts peak-to-peak as measured on the scope, and compare the curve with the one shown in Fig. 13B. Repeat any steps that are needed to improve the overall IF curve.

4.5-MHz Trap Adjustment

1) Change the function switch to MODULATED MARKERS and switch on only the 41.25-MHz and 45.75-MHz markers. Connect the generator direct probe to test point S (near the picture tube grid connections). Defeat the color killer by connecting a clip lead between test points K and KK.

2) Use maximum scope gain, and reduce the ATTENUATOR until the sine wave is quite small. Adjust L202 for minimum sine-wave pattern on the scope.

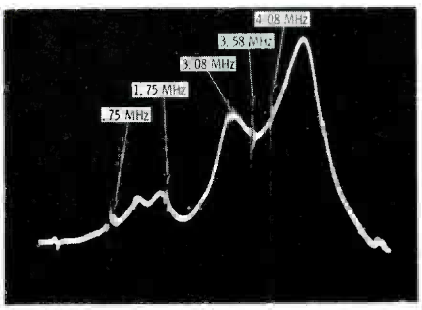


Fig. 15 Alignment curve of the 2nd chroma IF stage.

VSM CHROMA Alignment

NOTE: The 14A9C51 Zenith chassis has only one alignment adjustment in the chroma circuit. Refer to the simplified schematic in Fig. 14. L214 is a very broadly tuned bandpass transformer; L216 has no core and is resonant to about 5.0 MHz. Additional tuning is provided by the series-resonant circuit, C259 and L222, in the emitter circuit of Q206, the second color amplifier. These fixed-tuned components provide extra gain at 3.08 MHz (see Fig. 15). Zenith does not list a procedure for VSM alignment; the following method was developed through trial and error and our experience with other models:

1) Turn the function switch to IF and the CHROMA switch to ON (this provides a 45.75-MHz carrier that is modulated by swept video). Switch off all markers, then turn on 41.25-MHz (4.5-MHz in chroma frequency), 41.67-MHz (4.08-MHz), 42.17-MHz (3.58-MHz) and 42.67-MHz markers. The four lights on the chroma curve should be on.

2) Attach the demodulator probe to pin 3 of the IC demodulator (Fig. 16 shows the location of chroma components), slide the PROBES switch to DEMODULATOR, slide the VERTICAL switch to NORMAL and turn the chroma level control to the center of its range. (Make sure the clip lead is still connected between test points K and KK to defeat the color killer.)

3) Turn the ATTENUATOR control down until the waveshape no longer changes with small variations in the signal.

4) Reduce the SWEEP WIDTH, and adjust the CENTER FREQUENCY dial to center the curve and widen it until the four markers nearly span the screen. Adjust the horizontal centering on the scope to help in the centering process. Adjust the vertical gain to produce a waveform of normal height.

5) Adjust L214 to produce the curve shown in Fig. 17B.

NOTE: Out of curiosity, we checked the curve of the second chroma IF, which includes L216. The self-resonant point was so high (about 5 MHz, see Fig. 15) it seemed likely that the extra gain above 4.5 MHz would reduce the effectiveness of the 4.5-MHz trap, L202. A core borrowed from another coil was inserted into L216, and after adjustment it produced maximum gain at 4.08 MHz. The new curve seemed to be an improvement since it gave almost double the original chroma gain and reduced the unwanted signal above 4.5 MHz. Overall VSM alignment then was tried experimentally by adjusting L214 and L216 to give the excellent curve shown in Fig. 17C.

Chroma Alignment According to Zenith

The Zenith factory-recommended chroma alignment method is as follows:

1) Tune in a normal keyed-rainbow color-bar pattern.

2) Remove the 3.9K damping re-

sistor from L214.

3) Connect a VTVM to test point Q (ACC voltage which can also be measured at C253).

4) Adjust L214 for **minimum** negative voltage (expect a fairly sharp dip in reading), then reconnect the 3.9K resistor.

Color picture quality, after this pre-setting type of alignment, was satisfactory, but the curve was not as good as the one resulting from the VSM alignment.

Performance from the antenna terminals to the video detector should also be checked by adjusting the generator and receiver the same as you would for IF sweep alignment, except the OUTPUT pad should be switched to 300 ohms and attached to the antenna terminals, and channels 4 or 10 should be selected by the FUNCTION switch. If the curve tilts much when the fine tuning is adjusted, it is likely the tuner alignment in the receiver is not correct.

Summary

Performance of the B&K Model 415 Sweep/Marker Generator generally was excellent. When the instrument first was received, the ATTENUATOR control would not reduce the generator output signal enough. The B&K engineering department advised us to check the gate voltage on the FET whose bias is varied to change the signal amplitude. Adjustment of the "trimming" resistor (provided for initial calibration) gave smooth control over the signal and reduced the amplitude to less than the minimum that is needed. Evidently this control had slipped from its correct setting due to vibrations during shipment.

There is a slight droop in the frequency response below 2.5 MHz in the video and chroma sweep functions. This is of no consequence to color alignment since perfect flatness of sweep output is necessary only between 3.08 MHz and 4.08 MHz.

This instrument is not designed or intended for complete alignment of the antenna and RF stages in a tuner; however, this specialized type of alignment is seldom needed. Or if needed, it is delegated to the tuner repair companies. It **does** provide all of the necessary signals and functions for accurate and extremely fast b-w and color TV alignment.

The lighted marker positions on the simulated curves on the front panel of the instrument helped to remind us which markers were being used. I particularly like the multiple markers (which can be made horizontal), and the ease of changing from IF sweep to markers or to VSM sweep merely by sliding a few switches. ▲

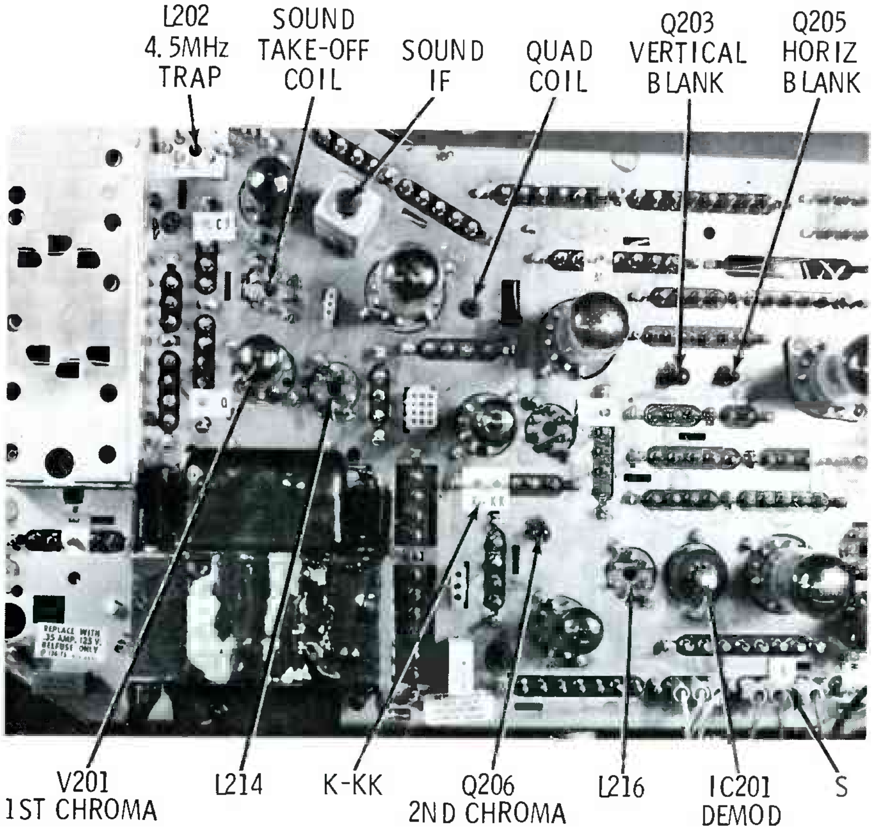


Fig. 16 Location of the chroma components and test points.

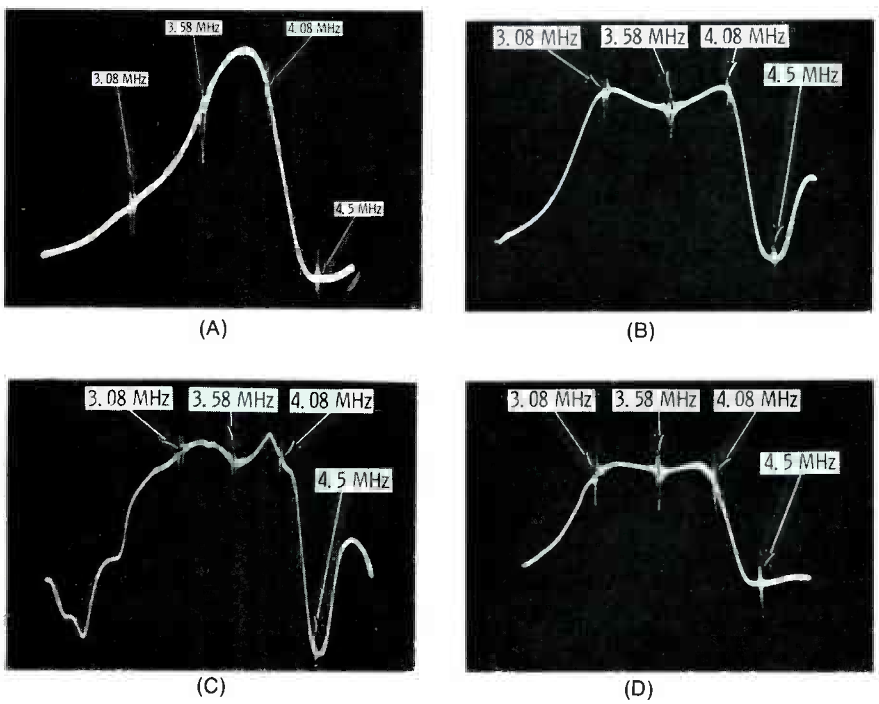


Fig. 17 A) VSM curve produced by the original Zenith factory alignment. B) The improved curve obtained after re-alignment. C) Example of a curve distorted by excessive signal amplitude. D) Excellent curve obtained by adding a core to L216 and touching up the chroma alignment.

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	Average No. Copies Each Issue During Preceding 12 Months	Single Issue Nearest To Filing Date
A. Total No. Copies Printed (Net Press Run)	69,532	59,885
B. Paid Circulation		
1. Sales through dealers and carriers, street vendors and counter sales	6,892	7,003
2. Mail Subscriptions	55,914	49,701
C. Total Paid Circulation	62,806	56,704
D. Free Distribution (including samples) by Mail, Carrier or Other Means	2,208	621
E. Total Distribution (sum of C and D)	65,014	57,325
F. Office Use, Left-Over, Unaccounted, Spoiled after Printing	4,518	2,560
G. Total (sum of E & F—should equal net press run shown in A)	69,532	59,885

I certify that the statements made by me above are correct. (Signature of editor, publisher, business manager, or owner).

ROBERT E. HERTEL

product report

for further information on any of the following items, circle the associated number on the reader service card.

Air Filter Cleaner

Now available from NYCO Products Co. is a non-flammable, non-corrosive air filter cleaner. One part of NYCO Electronic Air Filter

Cleaner with 40 parts hot water reportedly cuts heavy grease film, dirt and soot after a 15-20 minute soaking and water rinse. The product has no chlorine solvents, carbon tetrachloride, naphthas or benzenes. Price of one gallon in plastic container (4/case) is $3.75 and of one quart (12/case), $1.25.

Circle 64 on literature card

Electrical Contact Lubricant

A contact maintenance compound, Electrolube, which reportedly does not contain mineral oil, hydrocarbons or silicones, has been introduced by Trans Atlantic Electronics.

This product acts as a conductor when applied between contact surfaces by increasing the contact area and, thereby, substantially reducing contact resistance, according to the manufacturer.

Electrolube has a negative temperature/resistance coefficient which prevents overheating of contacts at high loads. It is non-flammable and can be used in environments up to 240°C, according to the manufacturer. Existing tarnish or corrosion is lifted and a tenacious film protects against subsequent cor-

rosion. It can also be employed as a high-quality mechanical lubricant, states the manufacturer.

Electrolube is available as an oil or grease, both in bulk and aerosol form. Shown is a refillable 2-oz. bottle with a patented snorkel de-

Circle 33 on literature card

Circle 34 on literature card

vice for spot application in hard-to-reach areas.

The price of the 2-oz. snorkel bottle is $5.00, less quantity discounts, and is available in quantities of up to 5 quarts.

Circle 65 on literature card

Spray Cleaner and Degreaser

Injectorall has made available a new all-purpose cleaner and tuner degreaser called CLEAN.

The manufacturer states that CLEAN, which comes in a spray can, is a fast-drying solvent that leaves no film, is non-flammable and quickly dissolves all types of dirt, grease and oil.

It has a toxicity of 500 parts per million as opposed to 25 parts per million in carbon tetrachloride, which makes it safer to use, according to Injectorall.

CLEAN is a solvent for contaminants such as mineral oils, greases, waxes and soils and can be used on glass, ceramics, metals and plastics. It is also stated that CLEAN may be used on printed-circuit boards, photographic film and electronic assemblies where it is important to

have a clean, dry surface with no residue after cleaning.

CLEAN is available in a 24-oz. spray can, catalog No. 3-24, which comes equipped with a plastic nozzle for pin-pointing and concentrating the spray area. The price is $3.00.

Circle 66 on literature card

Magnifier

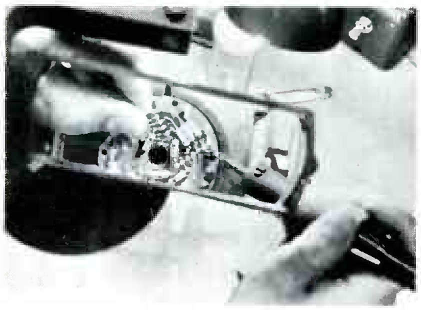
The OCVI* WideScope Work/Viewer has been introduced by the Ocvi Instrument Division of the Ednalite Corporation.

The Work/Viewer is a magnifying instrument designed for viewing with both eyes. It aids technicians who need to weld, solder or inspect small or miniature components and products.

According to the manufacturer, the OCVI WideScope Work/Viewer has ultra-high resolution, which results in unusual clarity and brilliance of the details of the object being viewed. Ednalite also states that color fringing or blurred, different color images are eliminated. The Work/Viewer is also said to have depth of field, which means that an object can be moved from the ideal focusing position without loss of sharpness of the image.

The viewer is equipped with a

Versatilt Arm for positioning the lens and it can be used either with the Ocvi WorkTable with illumina-



tion from below or with the Ocvi StrutSpot for illumination from above. The Work/Viewer is available with 2.5x and 4x magnification, both of which can be doubled by a built-in magnification multiplier that provides monocular capabilities of 5x and 8x respectively.

The cost of the OCVI* Wide-Scope Work/Viewer ranges from $129.50 for 2.5x magnification to $179.50 for 8x magnification.

Circle 67 on literature card

Heavy-Duty Equipment Cart

Technibilt Corporation has designed a demonstrator cart for use in transporting heavy electronics instruments or equipment.

The cart is collapsable for storage or transporting. According to the manufacturer, the formica-covered top deck locks securely in place and will withstand loads of

up to 350 lbs. The deck can be removed from the cart along with its load onto another work area by sliding it on the small rollers attached to the bottom front of the deck.

Technibilt reports that the cart is made of chrome-plated steel tubing with wheels of solid rubber. The larger rear wheels are said to provide easy maneuverability for rolling up or down inclines or obstacles. The size of the top deck is 19¼" x 24" and the lower, wire deck size is 13" x 21".

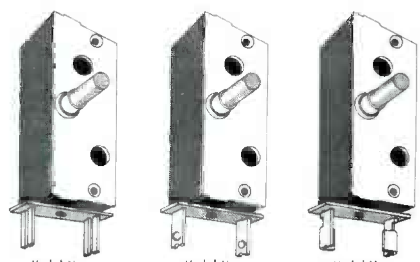
The cost of the cart is $58.50.

Circle 68 on literature card

Circuit Breaker/Fuse

Circuit breakers with amp fuse pins have been introduced by Workman Electronic Products, Inc.

The FA fuse is designed to be used while diagnosing troubles in television sets. In television repair involving a blown chemical or amp fuse, several fuses can be blown be-



Model No. FA 350–1 | Model No. FA 1000–1 | Model No. FA 2000–1

fore trouble is found, states Workman. The FA fuse is said to eliminate this problem as it can be reset as often as needed or until the cause of the breakdown is found. Workman also states that the FA fuse can be left in the set after the repair is made.

The fuse comes in three different models: Model No. FA 350-1 (green) Model; No. FA 1000-1 (white); and Model No. FA 2000-1 (maroon). Workman states that the fuses have the same carry and break currents as the chemical or amp fuse with the same model number.

The fuses sell for $1.73 each.

Circle 69 on literature card

Low-Voltage Panel Lamp

The Mura Corporation announces that Muralite lamps, used in original equipment by hi-fi, TV and stereo manufacturers, are now available to electronic technicians as replacements.

The Muralite Series L assembly consists of a blister-packed replacement lamp with 6-inch insulated

leads, stripped and tinned, plus five colored lens caps (white, red, green, blue and amber).

The plastic lens cap snaps into the panel board and the lamp is then pressure-fitted inside the cap, according to the manufacturer. A 19/64-inch mounting hole is used.

It is stated that the Series L lamp assembly may be used for tape recorders, hi-fi receivers, indicator lamps, on-off lights and similar equipment. The Mura Corp. guarantees the units for 10,000-hours life at voltages from 2 to 28 volts and current from 20 to 60 ma.

The price of the Muralite Series L lamp is $.49.

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ELECTRONIC SERVICING . . .* the country's only magazine devoted 100% to the *ELECTRONIC SERVICING industry . . .

Circle 39 on literature card

catalogs literature

AUDIO

100. *Workman Electronic Products, Inc.*—has released Audio Accessories Catalog No. 116, which includes their lines of cables, adapters, sockets and plugs and universal replacement microphones.*

MISCELLANEOUS

101. *Allied Radio Corp.*—has issued a 552-page 1970 catalog, No. 290, which illustrates and describes major brands of all types of home and auto electronic entertainment units and accessories plus hobby kits; test equipment and meters; antennas and their accessories; tools; technical books; and electronic parts, tubes and semiconductors. Specifications are included.

102. *State Electronics Parts Corp.* — has introduced an illustrated 308-page reference book, No. 701, which lists over 80 brand name lines of electronics parts and equipment, along with quantity prices.

SERVICE AIDS

103. *Chemtronics, Inc.*—has issued an 8-page catalog covering their line of tuner sprays, contact and control cleaners, insulating sprays, lubricants, circuit coolers and their other chemical sprays.*

SPECIAL EQUIPMENT

104. *Electronics Div./American Relays* — has released a 100-page, illsutrated guide book, No. 7-69, covering the types, functions and applications of transducers.

105. *Heath Co.* — has released their 1970 116-page catalog of electronic kits. It features 66 full-color pages and lists over 300 assorted kits.

106. *Reflector Hardware Corp.*—24-page, full color, illustrated catalog presents their full line of Contempo and Jupiter floor-to-ceiling structural uprights for merchandising and display purposes, with accessories also listed.

107. *Underwriters' Laboratories, Inc.*—has made available an illustrated brochure which explains UL's product tests for public safety.

TECHNICAL PUBLICATIONS

108. *Howard W. Sams*—Literature describes popular and informative publications on radio and TV servicing, communication, audio, hi-fi and industrial electronics, including 1969 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

109. *Lambda Electronics Corp.*—a 16-page catalog, including specifications, price information and ordering data on their four new lines of power components, power instruments and power systems.

110. *Motorola Communications and Electronics, Inc.*—has issued a 36-page precision instruments catalog, No. TIC 3515, which contains both general purpose test equipment and special two-way radio test equipment and service aids.

TOOLS

111. *Colbert Ind.*—has released an 8-page illustrated catalog-manual, No. 170, which shows more than 25 ways their PANAVISE tool system can be used.

112. *Janel, Inc.*—announces a 3-color catalog on their line of electronic tools, primarily used in miniature and micro-miniature electronic assembly and production applications, and includes illustrations and prices.

***Check "Index to Advertisers" for additional information.** ▲

advertisers' index

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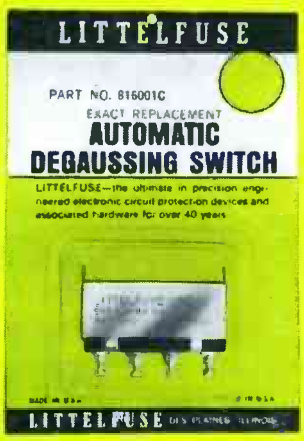

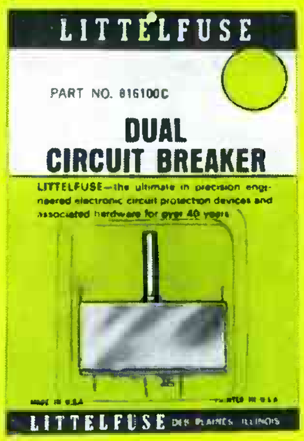

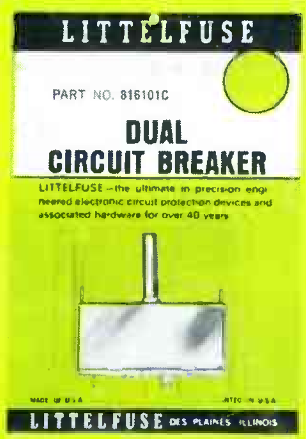

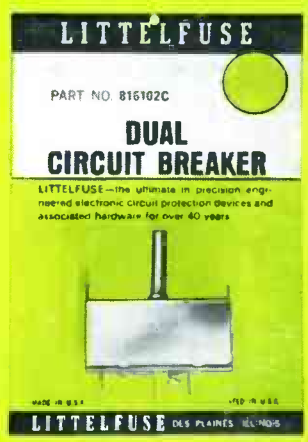

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