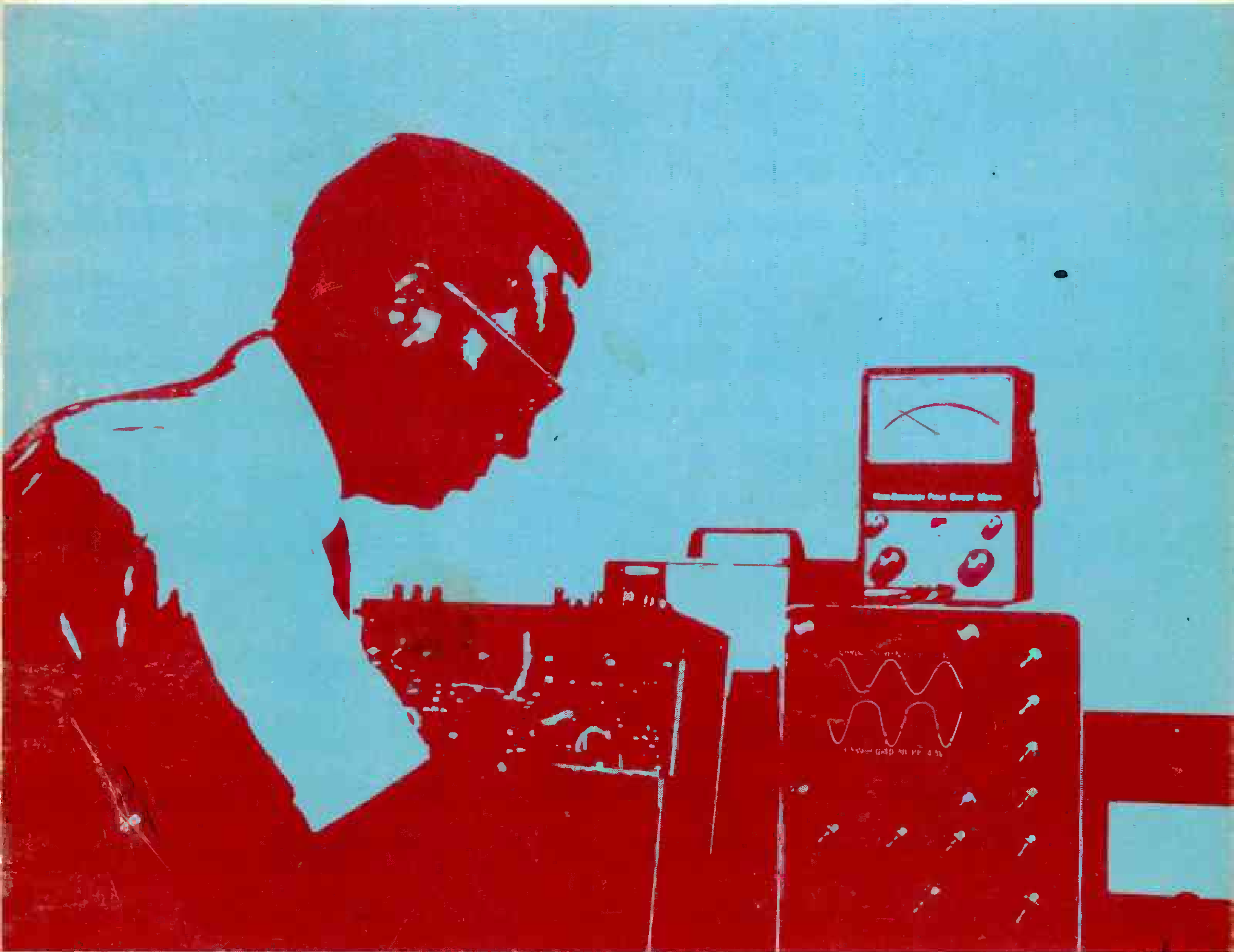
August, 1972 75 cents

A HOWARD W. SAMS PUBLICATION

Electronic Servicing®



August 1972 • Volume 22, No. 8

Electronic Servicing®

ANTENNA SYSTEMS

AUTO ELECTRONICS

COLOR TV

GENERAL ELECTRONICS

SHOP MANAGEMENT

DEPARTMENTS

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μF	D. x L.	Sprague Products Cat. No.
.02	29/64 x 15/16	2PS-S20
.022	29/64 x 15/16	2PS-S22
.047	33/64 x 15/16	2PS-S47
.05	33/64 x 15/16	2PS-S50
.1	35/64 x 1 1/4	2PS-P10
.15	5/8 x 1 1/4	2PS-P15
.2	43/64 x 1 3/8	2PS-P20
.22	43/64 x 1 3/8	2PS-P22
.25	43/64 x 1 3/8	2PS-P25
.33	11/16 x 1 11/16	2PS-P33
.47	49/64 x 1 11/16	2PS-P47
.5	49/64 x 1 11/16	2PS-P50

400 VOLTS D-C

μF	D. x L.	Sprague Products Cat. No.
.01	15/32 x 3/4	4PS-S10
.015	33/64 x 3/4	4PS-S15
.02	31/64 x 15/16	4PS-S20
.022	31/64 x 15/16	4PS-S22
.025	31/64 x 15/16	4PS-S25
.03	17/32 x 15/16	4PS-S30
.033	17/32 x 15/16	4PS-S33
.04	33/64 x 1 1/4	4PS-S40
.047	33/64 x 1 1/4	4PS-S47
.05	33/64 x 1 1/4	4PS-S50
.056	37/64 x 1 1/4	4PS-S56
.068	37/64 x 1 1/4	4PS-S68
.075	37/64 x 1 1/4	4PS-S75
.1	41/64 x 1 1/4	4PS-P10
.15	43/64 x 1 3/8	4PS-P15
.2	43/64 x 1 11/16	4PS-P20
.22	43/64 x 1 11/16	4PS-P22
.25	43/64 x 1 11/16	4PS-P25

600 VOLTS D-C

μF	D. x L.	Sprague Products Cat. No.
.001	25/64 x 3/4	6PS-D10
.0012	25/64 x 3/4	6PS-D12
.0015	25/64 x 3/4	6PS-D15
.0018	25/64 x 3/4	6PS-D18
.002	25/64 x 3/4	6PS-D20
.0022	25/64 x 3/4	6PS-D22
.0025	27/64 x 3/4	6PS-D25
.0027	27/64 x 3/4	6PS-D27
.003	27/64 x 3/4	6PS-D30
.0033	27/64 x 3/4	6PS-D33
.0039	29/64 x 3/4	6PS-D39
.004	29/64 x 3/4	6PS-D40
.0047	29/64 x 3/4	6PS-D47

600 VOLTS D-C (cont.)

μF	D. x L.	Sprague Products Cat. No.
.005	29/64 x 3/4	6PS-D50
.0056	15/32 x 3/4	6PS-D56
.006	15/32 x 3/4	6PS-D60
.0068	15/32 x 3/4	6PS-D68
.0075	15/32 x 3/4	6PS-D75
.008	29/64 x 15/16	6PS-D80
.0082	29/64 x 15/16	6PS-D82
.01	29/64 x 15/16	6PS-S10
.012	31/64 x 15/16	6PS-S12
.015	31/64 x 15/16	6PS-S15
.02	35/64 x 15/16	6PS-S20
.022	35/64 x 15/16	6PS-S22
.025	35/64 x 15/16	6PS-S25
.027	17/32 x 1 1/4	6PS-S27
.03	17/32 x 1 1/4	6PS-S30
.033	17/32 x 1 1/4	6PS-S33
.035	17/32 x 1 1/4	6PS-S35
.039	19/32 x 1 1/4	6PS-S39
.04	19/32 x 1 1/4	6PS-S40
.047	19/32 x 1 1/4	6PS-S47
.05	19/32 x 1 1/4	6PS-S50
.056	41/64 x 1 1/4	6PS-S56
.06	41/64 x 1 1/4	6PS-S60
.068	41/64 x 1 1/4	6PS-S68
.075	41/64 x 1 1/4	6PS-S75
.082	11/16 x 1 3/8	6PS-S82
.1	11/16 x 1 3/8	6PS-P10
.15	47/64 x 1 11/16	6PS-P15
.2	27/32 x 1 11/16	6PS-P20
.22	27/32 x 1 11/16	6PS-P22
.25	27/32 x 1 11/16	6PS-P25
.33	59/64 x 1 11/16	6PS-P33
.47	1 1/64 x 1 11/16	6PS-P47

1000 VOLTS D-C

μF	D. x L.	Sprague Products Cat. No.
.001	25/64 x 3/4	10PS-D10
.0015	13/32 x 3/4	10PS-D15
.002	7/16 x 3/4	10PS-D20
.0022	7/16 x 3/4	10PS-D22
.003	7/16 x 15/16	10PS-D30
.0033	7/16 x 15/16	10PS-D33
.004	15/32 x 15/16	10PS-D40
.0047	15/32 x 15/16	10PS-D47
.005	15/32 x 15/16	10PS-D50
.0068	31/64 x 15/16	10PS-D68
.01	35/64 x 15/16	10PS-S10
.015	17/32 x 1 1/4	10PS-S15

1000 VOLTS D-C (cont.)

μF	D. x L.	Sprague Products Cat. No.
.022	37/64 x 1 3/8	10PS-S22
.033	19/32 x 1 3/8	10PS-S33
★.039	**43/64 x 1 3/8**	**10PS-S39**
.047	43/64 x 1 3/8	10PS-S47
★.056	**47/64 x 1 11/16**	**10PS-S56**
.068	47/64 x 1 11/16	10PS-S68
★.082	**49/64 x 1 11/16**	**10PS-S82**
.1	49/64 x 1 11/16	10PS-P10

1600 VOLTS D-C

μF	D. x L.	Sprague Products Cat. No.
.0005	1/2 x 7/8	16PS-T50
.001	13/32 x 7/8	16PS-D10
.0015	7/16 x 7/8	16PS-D15
.002	1/2 x 7/8	16PS-D20
.0022	1/2 x 7/8	16PS-D22
.003	7/16 x 1 1/8	16PS-D30
.0033	7/16 x 1 1/8	16PS-D33
★.0039	**31/64 x 1 1/8**	**16PS-D39**
.004	31/64 x 1 1/8	16PS-D40
.0047	31/64 x 1 1/8	16PS-D47
.005	31/64 x 1 1/8	16PS-D50
.006	17/32 x 1 1/8	16PS-D60
.0068	17/32 x 1 1/8	16PS-D68
.007	17/32 x 1 1/8	16PS-D70
.0075	17/32 x 1 1/8	16PS-D75
.008	5/8 x 1 5/32	16PS-D80
.01	5/8 x 1 5/32	16PS-S10
.015	21/32 x 1 19/64	16PS-S15
★.018	**3/4 x 1 19/64**	**16PS-S18**
.02	3/4 x 1 19/64	16PS-S20
.022	3/4 x 1 19/64	16PS-S22
.03	3/4 x 1 39/64	16PS-S30
.033	3/4 x 1 39/64	16PS-S33
.04	27/32 x 1 39/64	16PS-S40
.047	27/32 x 1 39/64	16PS-S47
.05	27/32 x 1 39/64	16PS-S50

2000 VOLTS D-C

μF	D. x L.	Sprague Products Cat. No.
.001	3/8 x 1 1/4	20PS-D10
.0015	27/64 x 1 1/8	20PS-D15
.0022	15/32 x 1 1/8	20PS-D22
.0033	33/64 x 1 1/8	20PS-D33
.0047	1/2 x 1 3/8	20PS-D47
.0056	37/64 x 1 3/8	20PS-D56
.0068	37/64 x 1 3/8	20PS-D68
★.0082	**39/64 x 1 3/8**	**20PS-D82**
★.027	**51/64 x 1 11/16**	**20PS-S27**

★New rating

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electronic scanner

news of the industry

Admiral Corporation has announced that the picture tubes in their 1973 models will carry a five-year adjustment warranty. For color TV's the basic warranty provides 90 days free labor, one-year warranty on parts and a two year warranty on the color picture tube. During the next three years, Admiral will replace (for the price specified in the warranty certificate) the defective one with a rebuilt color picture tube of the same size and type. Black-and-white tubes carry a one-year warranty, plus the exchange of a rebuilt tube for the price specified in the warranty certificate during an additional four years. Labor is not included in the replacement price of either color or b-w tubes.

Some 1973 cars will have an automatic antenna that will rise when the radio is turned on and will lower when the radio or the ignition isswitched off. The **Wall Street Journal** reports that the Tenna Corp. has received an order from a major manufacturer of automobiles for antennas of this type.

FCC grants waivers on the UHF tuner rule to 8 TV manufacturers. According to the **Wall Street Journal,** waivers have been received by Admiral, Philco-Ford, GTE-Sylvania, Packard-Bell, Wells-Gardner, RCA, TMA and Zenith to delay their compliance with the FCC rule that each UHF channel have detenting. The rule required that all new models (those with new circuitry or tube size) be equipped with an improved UHF tuner by January 1, 1972. Generally, these 8 companies received delays to the end of October, 1972. General Electric and Andrea also have asked for waivers on their receivers having remote control.

Five minutes of color TV programming is predicted for a video disc similar in appearance to an LP record. London Records, as reported in **Home Furnishings Daily,** intends to market the discs and a $275 single-disc player by 1974. Also planned is a fully-automatic player priced at $400 which could furnish a program of up to an hour. The turntable speed was not given, but the discs are rated at 144 grooves-per-millimeter. Prices of the discs are said to be very low compared to VTR tapes of the same playing time.

RCA introduces its first color TV CRT having in-line guns. A 15-inch V screen-size color picture tube was announced in June by RCA. General Electric and Sharp already have tubes with in-line guns, and Sylvania has said

(Continued on page 6)

they will have a 19-inch size by next year. An unusual feature of the RCA tube is that the deflection yoke and other components around the neck are permanently mounted. Installation and adjustment are said to be nearly as simple as that for a b-w tube. RCA expects eventually to produce this type of tube in 13-, 15-, 17- and 19-inch sizes. The aperture mask has vertical slits instead of holes, and the phosphors are in vertical stripes.

Patents on diodes expire soon. Patents covering semi-conductor diodes granted in 1955 to William Shockley, who later was one of the inventors of the transistor, expire in August, 1972. This news in **Radio & Television Weekly** reminds us of the short period of time which has passed since the discovery of solid-state principles.

Pay-TV is due for another test. Evidently the reports of the death of pay-TV were premature, for this fall TheatreVisioN will lease the facilities of Storer Broadcasting Company in Sarasota, Florida for a test involving 1000 CATV subscribers. According to **Merchandising Week,** a pre-programmed ticket inserted into the decoding device will unscramble the program material.

A student at the University of New Mexico has been named the top electrical engineering student despite his total blindness caused by a chemical explosion while he was in high school. Noel Runyan was chosen for this honor from the many candidates nominated by more than 200 chapters of Eta Kappa Nu, a national electrical engineering honor society. As part of his work, Runyan has invented devices which help the blind test electronic equipment. One such device converts the reading of a digital meter into Braille. Another changes the waveshape of a scope or the condition of an indicator light into varying sounds. A third mechanism indicates by sound which holes of an IBM card have been perforated. At home, Runyan has a workbench where he can reach up and select components or wires from bins, and then connect and solder a circuit as rapidly as most sighted persons.

The first meeting of the Technicians Advisory Council formed by Zenith was held April 24 and 25 in Chicago. The 16 men attending are independent service managers or technicians who were chosen by the 86 Zenith distributors. At this council meeting, the members were encouraged to discuss any subjects contributing to better quality, such as engineering, development, production, quality assurance, service and parts. Other meetings are planned for later dates, and Zenith hopes to obtain recommendations that will help them improve the quality and performance of Zenith products. □

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Just what you've been waiting for, a compact assortment of replacement fuses to service all popular domestic and foreign color television sets!

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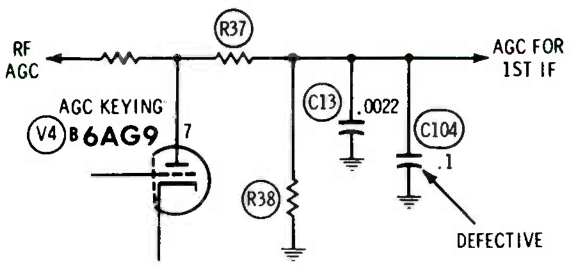
symcure

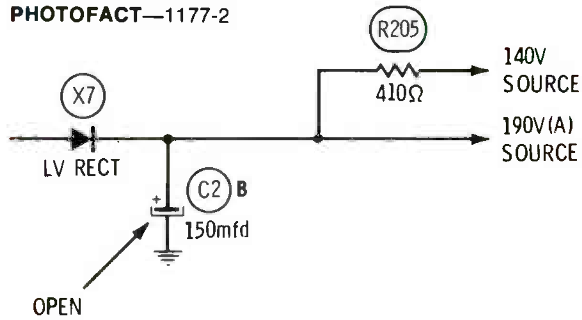
Symptoms and cures compiled from field reports of recurring troubles

Chassis—General Electric KE II
PHOTOFACT—1177-2



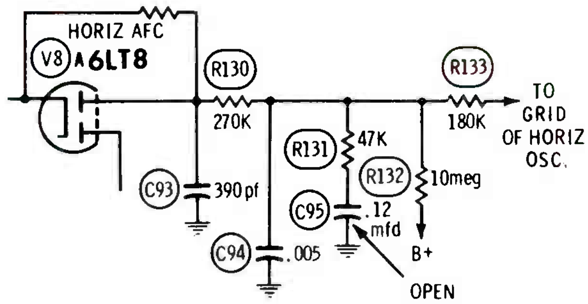
Symptom—Snowy picture
Cure—Check C104 and replace, if shorted

Chassis—General Electric KE II
PHOTOFACT—1177-2



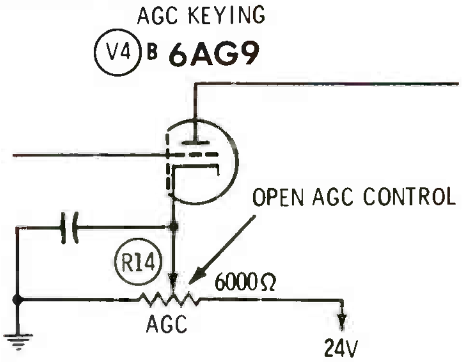
Symptom—60-Hz hum bar, and picture bending
Cure—Check filter capacitor C2B and replace, if open

Chassis—General Electric KE II
PHOTOFACT—1177-2



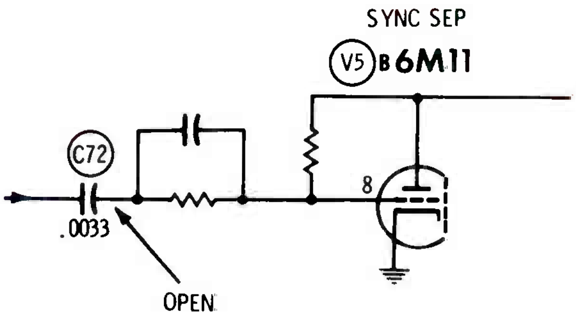
Symptom—"Pie crust" or "cogwheel"
Cure—Check C95 and replace, if open

Chassis—General Electric KE II
PHOTOFACT—1177-2



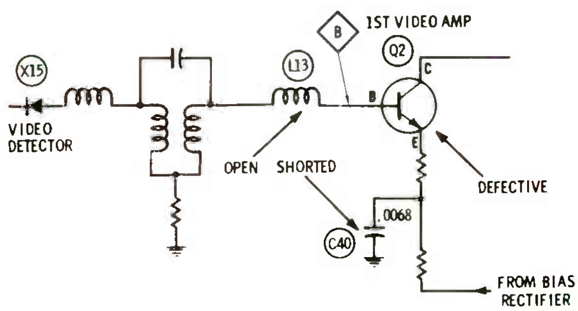
Symptom—Picture is dark and bends
Cure—Check R14, the AGC control, and replace, if open

Chassis—General Electric KE II
PHOTOFACT—1177-2



Symptom—Poor vertical locking and horizontal bending
Cure—Check C72 and replace, if open

Chassis—General Electric KE II
PHOTOFACT—1177-2



Symptom—No video
Cure—Check L13, C40, and Q2 and replace, if defective □

How to stay in shape without getting your wallet out of shape.

We've shaped up a plan that lets you mix business with pleasure.

The program is simple: You buy Sylvania receiving tubes, you get merchandise award points. When you have enough points, you just pick out what you want from the catalog that Sylvania's distributors will be glad to give you. (Ask him for the "Take Stock with GTE Sylvania" book.)

To keep you in shape, there are things like golf or fishing equipment and shop tools. And if whittling is your sport, there's even a knife for that.

If you'd rather keep your wife in good shape there are pages of kitchen and household equipment that will make her workload a lot lighter.

Or if you are interested in really living the good life, there is everything from clothing to cameras.

And then there are the Sylvania color television sets. They take a lot of points, but they deliver a lot of picture.

Buying Sylvania receiving tubes can keep your business in good shape.

And if you buy enough Sylvania tubes, you can keep the whole family in shape.

But, we have to warn you: your wallet will get a lot fatter.

Sylvania Electronic Components, 100 First Avenue, Waltham, Mass. 02154.

GTE SYLVANIA

reader's exchange

Need a not-available schematic? Need an obsolete part? Have an unusual service problem and want help? Send information and full mailing address to ELECTRONIC SERVICING. Other ES readers should send replies with their offer of help direct to the writer. We reserve the right to edit and print all letters sent to this column. **Let us help one another.**

Needed: *(1) schematic and operating instructions for a Dumont scope, model 241, and (2) schematic and operating instructions for a General Electric sweep generator type ST4A, model 4ST4A1.*

D.A. Tice
710 Mineral Springs Road
Durham, North Carolina 27703

Needed: *schematic, voltage readings, etc. for a Singer color TV model HE8001.*

J. L. Cromer
Cromer's Radio & TV Service
557 E. Main Street
Laurens, South Carolina

Needed: *a schematic for a Chrysler FM-tape player model AB-239-2939.*

E. J. Brusso
92 Oakwood Avenue
Elmira Heights, New York 14903

Needed: *schematic and service data for a Victor Of Japan color TV model P-119.*

Terrill's Radio & Appliance Service
1015 Eighth Street
Oswego, Kansas 67356

Needed: *Replacement parts or an address of a distributor of parts for an OKI tape recorder model 300D. A letter sent to the Chancellor Electronics, Inc., 457 Chancellor Avenue, Newark, N.J. was returned marked "Moved, not forwardable".*

Earl C. Bookwalter
AVVESCO
144 E. San Mateo
Santa Fe, New Mexico 87501

Needed: *Schematic and data for an electric-eye control made by Standard Int., type 7208AOAQALX. The scanner operates okay on blue and black colors, but will not pick up orange or red.*

Charles C. Pryaly
1734 W. Crystal Street
Chicago, Illinois 60622

Editor's note: Most electric-eye units operate over a very narrow range of light. Perhaps this one is working normally. The response to light is determined by the characteristics of the cell and any light filters which might be used.

Technical advice needed: *The picture on a Philco 15J27 chassis appears to be upside down and backwards. The lower half of the picture is upside down and the top is blank. AC drive voltage at the grid of the vertical output tube is about 50% low.*

Jay R. Ciampi
17700 SW 111th Avenue
Miami, Florida 33157

Editor's note: It seems likely someone else has installed a new yoke and used the wrong type or wired it incorrectly. Perhaps the vertical and horizontal windings have been reversed.

Technical advice needed: *First symptoms of a Magnavox Chassis T93304AA color receiver were an intermittent increase of brightness lasting about 10 seconds, accompanied by vertical roll and blooming. Symptoms now are that the color is out-of-lock and the killer cannot cutoff the color. After 10 minutes the color leaves. Is there any connection between the two sets of symptoms?*

C. L. Schatzman
1039 Reinhard Avenue
Columbus, Ohio 43206

Technical advice needed: *After this Zenith Chassis 14M29 has operated for a few minutes, horizontal bars are triggered on by any channel change. The bars remain until the set is allowed to cool.*

B. B. Lee
5400 Mackey, No. 1
Merriam, Kansas 66202

Editor's note: These symptoms are typical of an oscillation in the RF amplifier in the tuner, or oscillation in the IF stages. Refer to page 65 of the October, 1971 issue of ELECTRONIC SERVICING for tips about symptoms and alignment of RF amplifiers. A fast test is to bias-off the RF amplifier. If the bars are eliminated, the RF amplifier is at fault. If the bars remain, suspect the IF's.

Technical advice needed: *The blue convergence of a Philco Chassis 20KT40B changes during the time it is turned off. Also the blue dots don't appear to move enough during convergence.*

Charles Stowall
C. Stowall's Radio & TV Service
6067 Whitewood
Detroit, Michigan 48210

Editor's note: This symptom in other models has been caused by an intermittent diode on the convergence board. Convergence coils around the neck of the CRT can open, but usually are not sensitive to heat or length of operation. □

editorially speaking

In the Electronic Scanner department last month was the announcement that the "old" Technical Editor is now the "new" Managing Editor.

Other changes inevitably follow any change in editorship. A magazine must (and should) reflect some of the editor's personality and ideas.

Some new approaches to our industry, and expansions of helpful and interesting features are on the way. Three new departments start in this issue. Details of other changes can't be given as yet; watch for them in coming months.

Cooperation and help **between** *individual ES readers are the goals of the new department "Readers Exchange". If you need a schematic not available through Photofact or the manufacturer, or if you want suggestions for the solution of a sticky technical problem, write to us and we will print a condensed version of your letter, complete with your full name and mailing address. Then, other ES readers should write direct to the technician who has the need.*

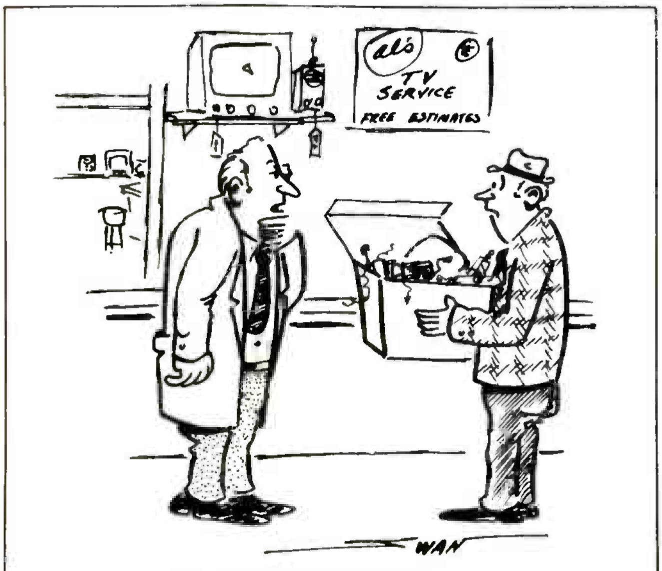
Every technician has amusing incidents happen to him. Share them with your fellow techs by sending the details to "ES Reader Chuckles" c/o the editor.

Do you want to learn more about some specific area of electronic theory or of practical repairing? Send us your suggestions for future articles. Also, tell us the type of article, subject matter or author you enjoy the most.

Your editor intends to give his ideas about the many problems facing our industry. Not that his opinions are necessarily of any more value than that of any other technician. But, hopefully, these thoughts should stimulate discussion which can be of benefit. □

Address all letters to:

Managing Editor
Electronic Servicing
1014 Wyandotte Street
Kansas City, Missouri 64105



"Offhand I'd estimate $3.00 for the parts and $350.00 labor."

service bulletin

a digest of info from manufacturers

Intermittent 60 Hz hum bar
Philco "S", "T", "U" and "A" line

Intermittent hum bars in the picture of the receivers listed might be caused by a poor ground at the eyelet in the corner of the panel near the 6MG8 video-amp/sync-separator tube on the sweep panel.

Resolder this connection, and also add a wire from the connection to another good ground.

Intermittent 6KD6 heater
Philco-Ford 1972 models

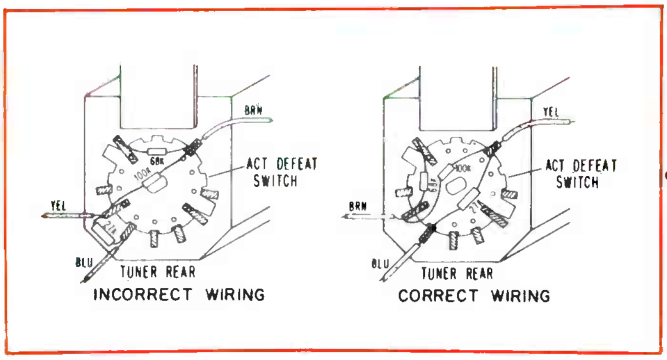
Intermittent lighting of the 6KD6 heater in any models using this type of tube might be caused by a poor ground return at the grounded lug of the terminal strip. The rivet holding the strip to the chassis might be loose.

Solder a wire from the grounding lug to another ground point.

ACT lockout
Philco-Ford 20QT90 chassis

A blank raster when the ACT is switched on, and normal operation with it off might indicate a miswiring of the ACT defeat switch in Philco 20QT90 chassis containing a TT214 (76-14219-1) VHF tuner.

Check the wiring of the ACT defeat switch, and correct it, if necessary, according to the drawing shown here.



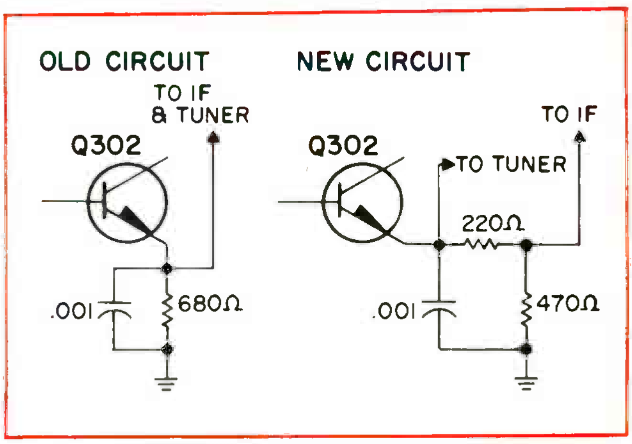
Courtesy of Philco-Ford

Loss of horizontal locking during channel change
Sylvania D14, D15 and D16 chassis

An intermittent loss of horizontal locking during channel changes with any of the listed early-production chassis (which do not have the video-buffer stage) can be corrected by the following modifications:

- Change the emitter resistor of Q200, the 1st IF transistor, from 15K to 8.2K ohms. This value has been changed in some chassis.

- Modify the AGC-amplifier circuitry as shown in the schematic.
- Reduce the value of R334 (in the base circuitry of Q308) from 470K to 390K. Caution: do not use a lower value, for horizontal phasing might be affected, or horizontal jitter might appear on weak signals.
- Increase the value of C304, the AGC filter capacitor, to double the original value. Caution: do not use a value larger than recommended, or the effects of aircraft flutter might be increased. □



Courtesy of GTE-Sylvania

CUSTOMER RELATIONS . . .
They Can Break You, Or Make You A Success

By Robert G. Amick/ES Business Consultant

Good relationships between your customers and you or your employees are important to the success of your business.

No business can prosper for long if too many customers **feel** put-upon. Notice I said "feel". You may never **intend** to offend or short-serve them, but you must be concerned if they **think** you have "taken" them. Such problems should be solved before they happen.

Beneficial customer relations don't exist without effort; they must be planned, polished, and executed just as other business methods are.

When you must make a choice of approaches, use this thought as a guide: "Which course will benefit my business the most in the long run?" Many easy, expedient actions are illusions that trap us even deeper. Plan ahead.

"But if I make an exception in your case, everyone will want parts and service on credit, Mom."

Customer relations are based on the quality of three things:

- **Trust** or confidence your customers have in you and your business,
- **respect** you show for the individuality of your customers, and
- the **image** you project.

Trust Or Confidence

Most business activity is founded on trust. Trust in the brands and reputations of the goods or services sold, and also trust in the man who's doing the selling. Either kind of trust can keep a business in operation. However, **maximum** growth of any business demands the best of both types of trust.

Those of us who perform services must rely even more on trust. Service is more personal, and the regard of our customers for us becomes paramount. This is especially true in the servicing of household electronic products. The customer doesn't understand exactly what needs fixing, and he doesn't know whether the job is difficult and time-consuming or simple and quickly done. Thus he has a sense of frustration and helplessness which must be offset by his confidence in **you.**

His trust (or the lack of it) is earned in part by your reputation from other jobs in the past. Also it is inspired in the present by your actions, appearance and language. Here are some things affecting his trust of you:

- Make reasonable promises, then keep them.
- Look, act and talk as though you know your business.
- Answer a technically-oriented question completely enough to show you know all about it, but briefly enough not to confuse the customer.
- Don't hesitate to discuss prices or financing, when it is clear the customer wants such information. Don't let the price sneak up on him as an unwelcome surprise at the last moment.
- Don't act sly, secretive or furtive. Yours is an honorable profession; act as though you believe it.
- Answer and settle any complaints quickly and fairly. News of the customer's version travels fast. Stop it before it starts.

Ask yourself what traits and actions in other people cause you to trust them. Then try to acquire them for yourself.

Character assassination

Suppose you find that a competitor has made a serious mistake during a previous repair. Frankly, he goofed. It is only natural to want to get some approval by telling the customer all about it. Of course, we try to justify it as being for the customer's good. After all, look what a fine job you are doing after he fouled it up! But examine the situation a little deeper. Does this kind of revelation actually help you or anyone else?

There is an old cliche speaking of someone being "tarred with the same brush". That bromide certainly applies here. Can you emerge from this job a hero and your competitor a villain? No way! **Both** of you will lose the trust of the customer. To some degree, trust from customers to technicians is given or withheld according to the reputation of the entire industry. Like it or not, we are all in it together.

Better to restore the equipment to its normal condition, but say nothing. After all, you **are** getting paid for the job. Tell the story to your buddies in the shop, but not to the customers.

"George, could you give me a quick resume of today's **Guiding Light, Secret Storm,** and **Edge of Night?"**

Placing the blame

Shifting the blame for breakdown of the equipment to an outside party helps no one. For example, the customer might try to accuse the manufacturer of causing the defect by selling an inferior product. The technician, in an effort to direct the customer's anger at anyone except himself, agrees that they "Just don't build sets to last anymore". Now, if this transference actually helped anyone and harmed no one it would be worth while. But it doesn't help. The customer's trust of the industry (and you also) has suffered. Far better for the technician to make some offhand remark about the 400 separate operating parts in a color receiver, and not attempt to pinpoint the blame.

Respect Your Customer

Most service customers want to be treated as human beings having rights, ideas and feelings. Respect them and they are quite likely to respect you in return, with the added dividend of increased trust.

A customer is **not** "that old-model b-w combination out on Maple Street", or the "color TV that blows too many rectifier tubes". Customers are not jobs or machines; they are people who own machines and create jobs. Keep the people and machines separate in your mind. If you don't, many of your customers will sense it and react with resentment.

Of course, when you talk to a customer by phone or in person, do so in a courteous manner. That much is understood. But beyond this, don't do anything to give the impression you are bored, or that he is a bother and interrupting more important business.

Some service calls require making a mess in the customer's home. Be sure to clean up before leaving. That's common courtesy, and an unmistakable sign you are concerned about the customer.

Generally speaking, people react by returning kindness for concern, and understanding for thoughtfulness.

Handling The Difficult Customer

At about this point, I am sure some of you are wondering what kind of paradise I live in where the customers are not cheating, scheming, whining monsters such as the ones you deal with. Believe me, I have met my share of that kind, too.

But ask yourself what you gained by returning anger for anger and subterfuge for complaining. Perhaps it made you feel better for a few moments to be able to lash back and really "tell 'em off". But in all fairness, you must admit it solved nothing. The problem remained, more stubborn than before.

How should we solve personality conflicts and serious misunderstandings? First of all, accept his feelings for what they really are: frustration and disappointment. Perhaps his TV set was gone a week, came back C.O.D. and still doesn't work to his satisfaction. He's helpless, feels victimized, has missed his favorite programs for a week, and has paid for something he doesn't think he got. Some of his pent-up feelings are sure to spill over on you. Don't take it personally.

Don't argue with him, even if you try to do it patiently and reasonably. At best, you would be telling an angry man he was wrong. At worst, he might misinterpret and think you were calling him a liar. Let him blow off steam, and don't allow yourself to be drawn into side issues. More about this later when we discuss complaints.

After he cools off, he will realize you were treat-ing him with respect, even though at the time he really didn't deserve any.

Building A Favorable Image

One dictionary defines image as "a reflection of reality". That's close enough for our purpose. Putting it bluntly, you can't do much about acquiring a favorable image unless you have the qualities needed for one. All you can do is show people more of the real you. We who do business face-to-face with our customers are not given the luxury of building an illusion, as the politicians, movie stars and others do. We can't completely change our image, but we can improve it.

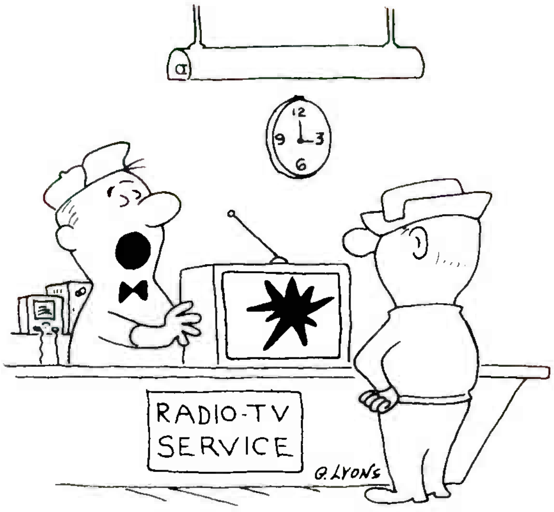
Take a day off from being "boss" and look at the image your business presents to your customers.

What about phone calls? After all, this is the first point of contact for most of your customers. Each call should be answered promptly and pleasantly. The person answering should identify both the business and himself. That makes the contact personal. Get all the data you need, and don't show impatience if the caller becomes too garrulous. If you must speed up the call, do so with regard to the customers feelings. Then thank him for calling your shop.

What about counter business? Do you use clear, simple forms on which the counter man writes all the essential data, including the complaint or symptoms? Is the name of your shop on the tags and forms, showing that you, too, have an identity you are proud of? Is your reception area neat, clean, and as attractive as possible for the neighborhood and the clientele? Remember that these things are more important to the customer (and your image) than technical proficiency which is hidden.

Now, suppose your counterman is a crusty type,

"Boss, in case old battleaxe checks in again about her TV, it's ready!"



"Sure, I can fix it while you wait! Did you bring your sleeping bag?"

who has a tendency to be abrupt, even rude at times. However, he does happen to be the best technician in your area. What do you do if one of your lady customers complains about **him?** Fire him? Defend him? How best to handle it?

First, thank the lady. She brought her complaint to you instead of spreading it all over town where it could really hurt you. And she trusted you enough to bring the complaint to you—rejoice in that. Tell her frankly that you have had other complaints about him and that you will talk to him again about his attitude. You might say, "I know he doesn't make you feel welcome, but he is the best technician for miles around. I hope this means enough to you that you'll continue to bring your repairs to us." Simple, direct and better than making vain excuses. Then have a talk with your "diamond-in-the-rough". Try to show him how little extra trouble it is to smooth his abrupt words and make the customer feel more welcome.

It is traditional that some of the most skillful technicians have the least amount of patience with people and their foibles. Try a short meeting of all your employees at least once a week and try to convince them to treat the customer with respect. If they do, they'll find their jobs are made easier.

Go out on several service calls with your outside man. Take a critical look at the service truck, the tools and test equipment. Do they look to an outsider like something a real "pro" would use? Notice the attitude and appearance of your technician. Does he inspire confidence? Does he get along well with the customers?

By improving in the ways mentioned, you will enjoy a better image, because everyone in the business has become more proficient in dealing with people.

Handling Billing Complaints

Trust, respect and **image** can be shattered by inept handling of complaints. And no shop or technician can escape entirely from receiving them. Even if we made no technical mistakes, no one can **always** spot parts that are on the verge of failure. Complaints will be minimized if you have built up strong customer trust in you, and you show that you respect the customer. But when complaints do come, take action immediately. Delay only makes the situation worse.

There is one type of customer who implies that he would pay gladly, if only the price were more reasonable. Reduce the price because it is the easy way out, and you have fallen into a trap. The customer will reason that if you can charge less and still stay in business, you must be charging too much all the time.

I know several dealers who say they **never** accept less than the first price they quote, regardless of how strong the complaint, or to whom else the customer appeals. They say that if word of such price reductions got around, all their customers would hear of it and expect the same. That is a good point. We should never give the false impression there is a huge profit which can be reduced at will.

On the other hand, there is an alternative. Tell the customer the job is fairly priced and cannot be reduced. However, as a gesture of good will, you will take a specified amount from your Customer Relations Fund (or your charity fund) and deduct it from the bill. If the customer still insists, deduct it, but list it separately on the receipt. You will have solved a potential complaint without compromising your pricing system, or your reputation and image in the area.

Or perhaps the customer argues that you should do the job for nothing, because of a previous repair. If you think it will be effective, explain in a reasonable manner the facts of the case. Perhaps he will change his mind and the complaint is solved. If not, don't argue or become angry, but come to a quick decision. Whether you decide to charge or not, announce the decision and stick to it without further comments or arguments. Don't debate; both of you can lose.

One very successful manager of a service business has an excellent method of resolving this type of complaint. If the facts justify it, he offers a settlement at no charge, and does so without a lecture. In case a full settlement seems unjustified, he decides what seems fair, but does not at this time announce it. He explains to the customer that the responsibility can't clearly be fixed. Then he closes by saying: "We really aren't fooling when we say we want you to be satisfied. Now, in view of what I've told you about the problem, what do **you** feel would be a fair adjustment?"

You might imagine that he "gives away the store"; but this has not been the case over a period of several years. Actually, many customers will suggest a settlement more favorable to the shop than the one he had in mind! How can that be?

"Would you have something for someone whose picture tube expired one day after the warranty?"

Well, he's avoided haggling, there's no arguments or bruised egos. He didn't demand to be trusted, but he reversed the roles and offered to trust the customer. Most people lean over backwards to be fair in return.

But suppose you find the customer has caused the trouble by abusing the machine and you can prove it. You are only being human if you feel like a victory celebration. Resist this urge to act triumphant. Just as it takes courage to admit you are wrong, it takes decency and compassion not to gloat over his mistake.

After you have solved one of these complaints, do you congratulate yourself and then forget it? No, at this time you should review the situation to see if the complaint could have been avoided. Was it a technical omission or mistake? Was the pre-delivery check too short or haphazard? Did the outside man fail to report some important local condition or intermittent symptom? Did one of the employees say something irritating, or fail to make a soothing remark when needed? Preventing complaints is much less expensive and nerve-wracking than solving them after the fact.

Conclusion

Customers are people; no better and no worse than we who serve them. Many potential problems from difficult customers can be avoided if we understand the reasons for their anger or crankiness and don't outselves react in kind.

Always conduct yourself in ways that will build trust. And treat customers with concern as individuals so that your image will be the kind that helps your business. A good image cannot be faked for long. As Ralph Waldo Emerson wrote: "What you **are** speaks so loudly I cannot hear what you say". □

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BY THE MAKERS OF BLUE STUFF FOR TUNERS

Circle 13 on literature card

Keeping HV under control, Part 1

by Allan Dale

The picture tube in a color television set draws a lot of current compared to black-and-white. When a video scene is unusually bright, total beam current of the three CRT guns might exceed 1.5 milliamperes (1500 μa). Under such a heavy load, high-voltage DC output might drop below the nominal 24 to 25 KV needed by a color CRT. Then when a darker scene reduces the CRT current, the high voltage might rise above 30 kilovolts.

That is, it could vary that much if there were no high-voltage regulation. This important circuit trys to maintain high voltage at a constant level. Low high voltage degrades focus, width, and brightness; overvoltage damages parts, and triggers arcs.

Overvoltage also can produce X-rays. High-energy electrons hitting anything, including the phosphors and glass of a picture tube, give off X-ray energy. If high voltage is held below 27 kilovolts, the glass in modern picture tubes shield whatever small quantity of rays develop. And most new regulator designs themselves can't contribute to X-radiation.

A Constant DC Load Current

Until the scare over X-rays about three years ago, the 6BK4 shunt regulator shown in Fig. 1 was almost universally popular. The 6BK4 constitutes a variable load on the high-voltage system.

Imagine this set of normal conditions. At one particular instant, video-voltage level causes a certain degree of brightness in a scene on the color picture tube. Suppose the CRT beams draw 1100 μa during that instant. The shunt regulator, in parallel with the CRT across the high voltage, has been set to draw an additional 500 μa. The total load pulls current through the high voltage rectifier at a rate of 1600 μa and the high-voltage system develops exactly 24 kilovolts.

Now imagine a brighter video scene demanding, for a time, perhaps 1400 μa through the CRT. More current drawn through the rectifier loads the horizontal sweep stage. The horizontal output pulses that drive the HV rectifier fall in amplitude; that lowers the high voltage.

Boosted B-plus, the 850 volts in Fig. 1, is lowered because it, too, develops from horizontal sweep pulses. This reduces positive voltage at the grid of the 6BK4 and lowers its conduction (raises its internal resistance). Now only 200 μa flows through the 6BK4. Combined with 1400 μa drawn by the CRT, the regulator current maintains a 1600-μa load on the high-voltage system. so the output DC stays at 24 KV.

Darker portions of a picture draw less picture-tube beam current. During that time, there is less load on the high voltage. The lightened load raises the amplitude of horizontal sweep pulses, and boosted B-plus goes up. More positive bias for the 6BK4 forces the tube to pass more current. If CRT current drops to, say, 800 μa during some gray scene, regulator current rises to 800 μa. The total high-voltage load is still 1600 μa.

Other conditions that tend to push high voltage up or down are opposed by the regulator action, too. If AC line voltage goes up, so does horizontal output, and thus high voltage. But higher boost goes with such action. And that drives the 6BK4 grid less negative relative to the fixed cathode voltage. The regulator is a heavier load, working to limit the high voltage rise.

An adjustable potentiometer lets you set the point of equilibrium for the regulator. The pot varies how much of the sensing voltage from the boost reaches the 6BK4 grid. Most manufacturers suggest their own ways of adjusting high voltage. To do it quickly and dependably, use a high-voltage probe such as one of those pictured in Fig. 2. Just clip the pigtail to ground and slide the tip of the probe under the rubber anode cover and against the second-anode connection. Then, with line voltage at 120 volts and receiver brightness turned down, set the high voltage to suit that picture tube. Large screens usually take 24, 25, or 26 KV. Smaller screens, 21 or 22 KV. The service manual tells you.

From a trouble standpoint, the capacitor between grid and cathode of the 6BK4 is the most vulnerable part. It shorts or leaks, causing the focus to fuzz up. Often the raster narrows on the left. The best clue: you can't see any change in high voltage when you turn the adjustment pot.

Sometimes a spark gap between grid and ground protects the regulator tube from flashovers. When the gap is defective, the capacitor takes an extra beating. Recurrent failure of the capacitor suggests replacing the spark gap too.

If high voltage is too high and can't be turned down, R4 might have burned open. Of course, you'd check the tube first, because a defective tube can cause the resistor to burn.

Protective "Hold-Down" Circuits

Designers of color receivers now shy away from shunt-type high-voltage regulators. Of 125 chassis introduced last season, only about 20 percent use shunt regulators. And half of those have an extra circuit to hold the high voltage down in case the regulator fails.

Variations of the 6EN4 shunt regulator circuit shown in Fig. 3 have come into popularity. The version shown here incorporates a **hold-down** circuit. Otherwise, as you can see by comparing Fig. 3 with Fig. 1, the stage operates the same as the 6BK4. Indeed, you may find the earlier tube in some brands, but with the hold-down circuit added.

Regulator biasing was already described. Boosted B-plus supplies the sensing voltage, which depends on the amplitude of horizontal-output pulses. Virtually all 6EN4 stages include C1 from grid to cathode, to smooth transients. Many have the spark gap.

The standout difference is the diode pair, D1 and D2. The cathode path is through them to the 405-volt B-plus supply. The anodes of D1 and D2 are more positive than their cathodes, so long as the 6EN4 conducts. The diodes are, for all practical purposes, a direct connection from the bottom of R4 to the 405-volt line. In that condition, the stage acts just like Fig. 1.

Meanwhile, most of the other parts develop a negative voltage that biases the grid of the horizontal output tube. C3 couples a pulse from the flyback transformer to rectifier diode D3. R7 and C2 smooth out the ripples to make pure DC. R6 feeds the negative DC to the horizontal output grid.

With D1 and D2 conductive, the junction of their anodes with R4 and R5 stays at approximately 405 volts. This positive voltage, coupled by R5 to resistor R6, bucks the negative voltage from R7. From these two voltages and the class-"C" drive bias the output tube develops on its own, just

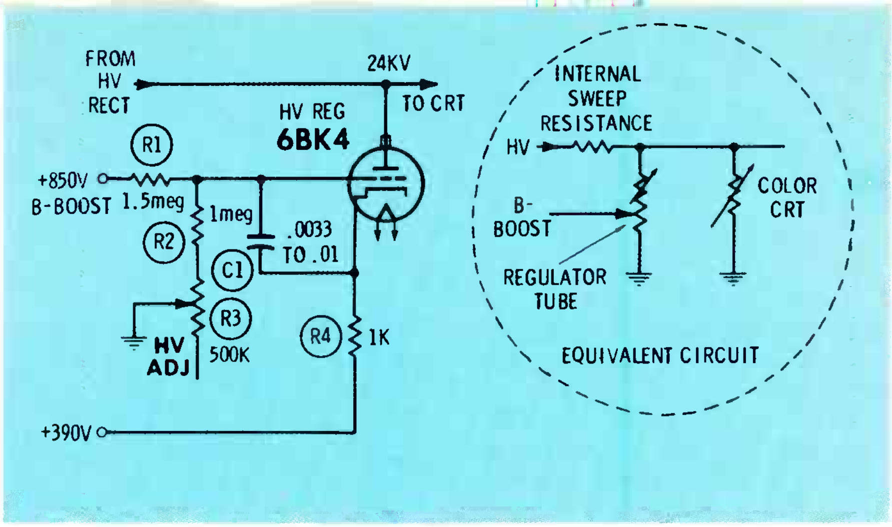


Fig. 1 This circuit is typical of the shunt-type high-voltage regulators used in the older color receivers.

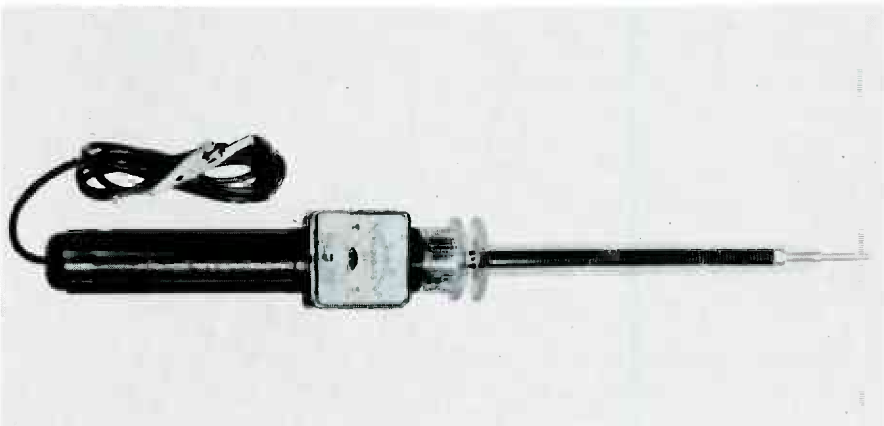


Fig. 2 High-voltage probes with built-in meters simplify measuring and adjusting the high voltage at the second-anode button of a CRT.

enough negative grid voltage is maintained to operate the output stage correctly.

Imagine the regulator tube opening up. The high voltage ordinarily would climb, perhaps to 30 KV or more. The reduced load would let horizontal sweep amplitude shoot upward. However, diodes D1 and D2 cease to conduct. Positive voltage no longer goes to R6 through R5. The negative voltage from R7, unhindered, biases the horizontal output tube further into cutoff—just enough to keep horizontal output within normal limits. High voltage stays at a safe level, although the width narrows and the focus is blurred.

Troubleshooting Hold-Down Circuits

One common trouble symptom is low brightness, sometimes with poor focus. Measuring, you find the high voltage low. With the set off, the way technicians often hunt high-voltage trouble, everything checks out normal. This trouble often comes from R2 opening up under load, sometimes intermittently. Too much positive voltage on the regulator grid loads the high voltage down heavily.

Some chassis have only one diode for D1-D2. If this single diode or R4 opens, the regulator tube ceases to reduce the high voltage. The 405 volts no longer can reach the cathode, so the tube can't draw any HV current.

Regulation of Output-Tube Bias

In color sets under two years old, most high-voltage regulator circuits don't have shunt-regulator tubes. The hold-down principle, incorporating a form of DC feedback loop from the flyback transformer back to the horizontal output grid, has gained acceptance. Of the new chassis models, more than 60 percent use this type of regulator.

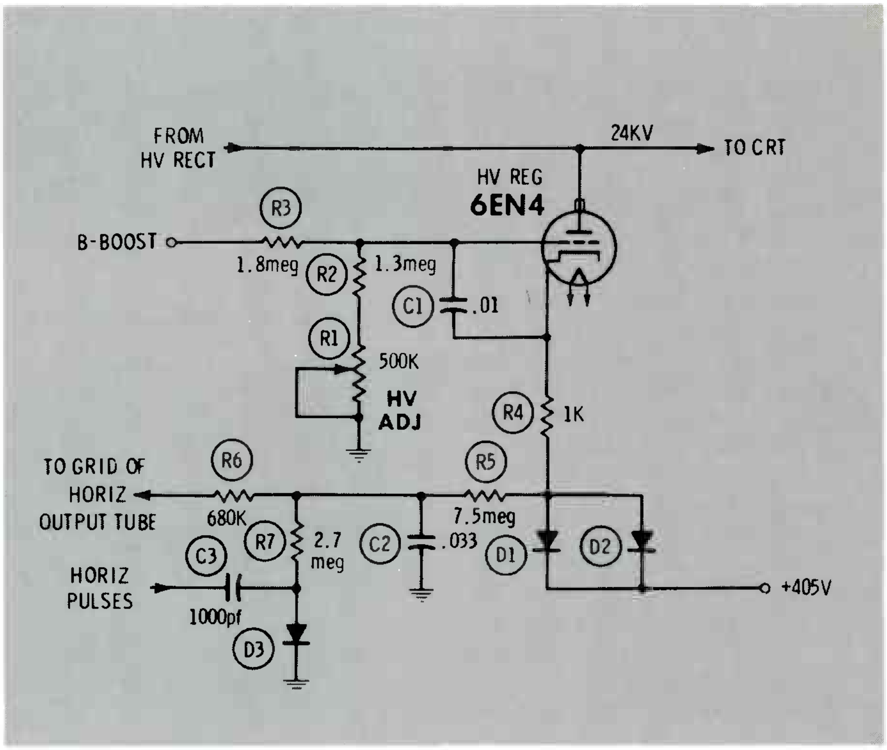


Fig. 3 To prevent excessive high voltage in case of failure of the shunt-regulator tube, diodes D1 and D2 act as gates to disconnect the B+ from R5. D3 rectifies pulses from the sweep system to produce a negative voltage that cancels the positive voltage through R5. When lack of current through the 6EN4 reverse biases D1 and D2, the negative voltage from D3 overbiases the grid of the horizontal output tube to reduce the sweep and high voltage.

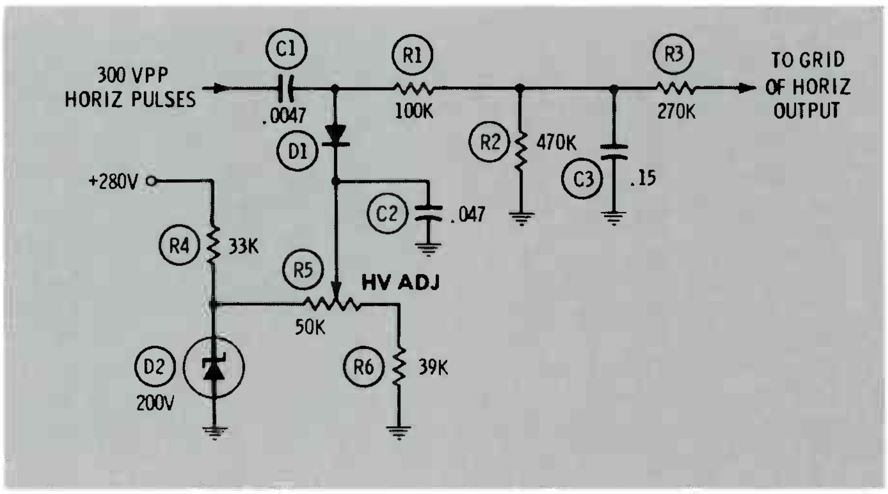


Fig. 4 This circuit regulates the high voltage by applying a varying negative voltage to the grid of the horizontal output tube. The negative voltage limits the maximum plate current, and thus the sweep and high voltage. When it leaks, D2 (which regulates the reverse-bias supply for D1) causes insufficient high voltage, poor focus and narrow width.

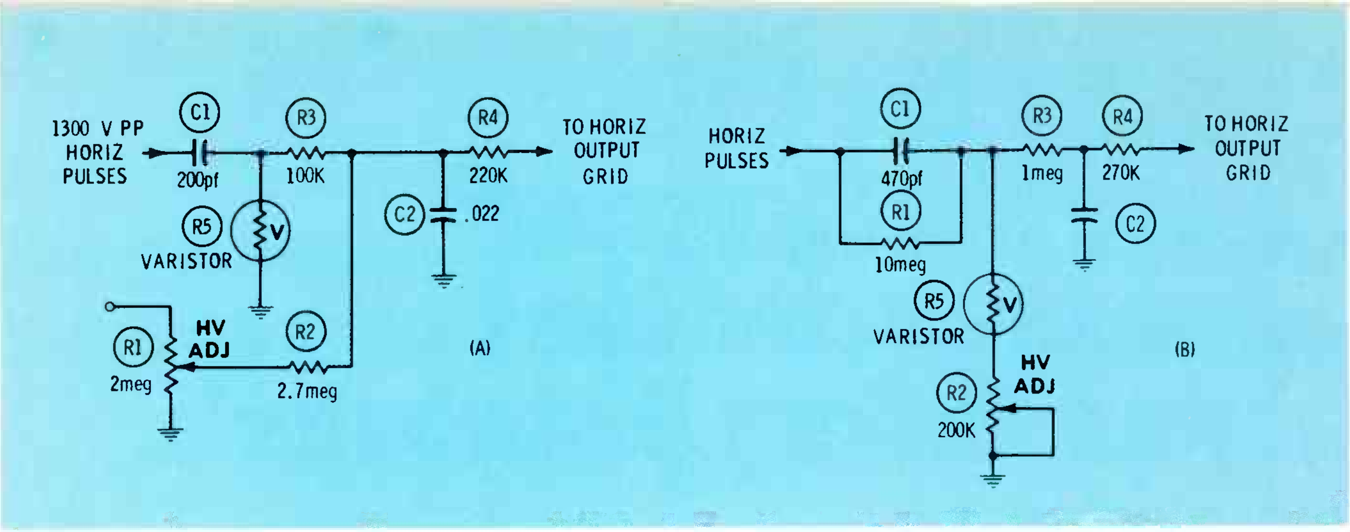


Fig. 5 Varistors can be used instead of diodes in regulator circuits designed for a larger amplitude of horizontal pulses. They are not interchangeable with diodes.
(A) An adjustable positive voltage from R1 is used to adjust the high voltage by cancelling most of the negative voltage produced by the varistor.
(B) A fixed value of positive voltage is brought in through R1, and a variable resistor (R2, the HV Adjust control) in series with the varistor reduces the amount of the negative voltage produced by the "rectification" effect of the varistor. The resulting control voltage is applied to the grid of the horizontal output tube.

The Magnavox circuit is diagrammed in Fig. 4. The key component, if one can be singled out, is diode D1. Its polarity is such that pulses from the flyback transformer develop a negative voltage for the grid of the horizontal output tube. That negative voltage is divided by R1 and R2, filtered by R1 and C3, and fed to the horizontal output grid by R3.

Conduction of D1 is determined by the 300 volts at the anode relative to the DC voltage at the cathode. Resistors R4, R5, and R6 form a divider across 280 volts B-plus. Zener diode D2, with R4, regulates exactly how much voltage appears across R5 and R6. The slider of R5 can be set to pick off any voltage between 90 and 200 volts. Applied to the cathode of D1, that positive voltage reverse-biases the diode. (C2 decouples the HV Adjust system from the horizontal pulses.)

D1 can't even conduct until the voltage rise of each horizontal pulse exceeds approximately the difference. For instance, if R5 is set to bias D1 at 150 volts backward, only the "top" 150 volts of the 300-volt p-p horizontal pulses is rectified. With R1 and R2 further dividing the DC, only about 30 volts negative gets to the grid of the horizontal output tube.

Move the slider of R5 to give only 100 volts bias to D1, and more of each horizontal pulse produces DC. The horizontal output grid might get 50 volts or more. Since that's negative, it cuts down maximum current of the horizontal output and reduces the high voltage. Move R5 to put nearly the whole 200 volts on D1's cathode, and less of the amplitude of each pulse is rectified. Bias for the output stage is less, and output and high voltage are both higher. That's how R5 adjusts the equilibrium value of high voltage.

So. . . how does this regulation work? Higher CRT voltage is accompanied by higher peak-to-peak pulse amplitudes. More negative DC is developed by D1 and passed by R1 and R3 to the horizontal output grid. That extra bias brings the output amplitude back down to normal, and lowers the high voltage.

Lower high voltage means weaker sweep pulses. Not as much negative voltage reaches the output grid. More pulse amplitude—more high voltage. The pulses fed back by C1 thus keep high voltage steady.

Failure of the zener diode has been recurrent. If D2 opens, high voltage goes up slightly. The reason: a bit more bias voltage for D1 means less negative bias for the output tube, and thus higher output. More commonly, however, D2 becomes leaky. The bias for D1 drops, negative voltage as the output grid increases, and high voltage goes down. Other symptoms include low brightness and sometimes a narrow raster. With some picture tubes, focus suffers.

"Rectification" By A Varistor

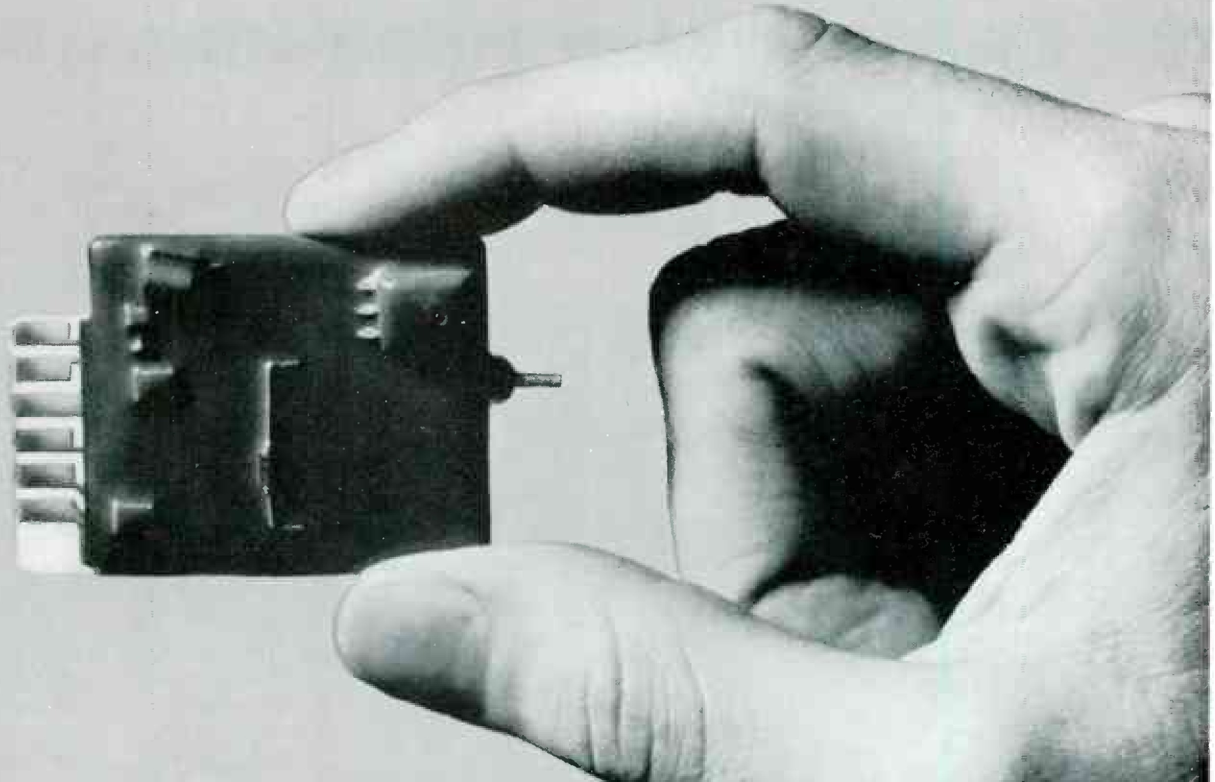
If higher pulse voltages are supplied by the sweep circuit, a varistor (voltage-dependent resistor, or VDR) can replace the diode in these circuits. Varistors are less prone to shorting from arcs or other overloads.

Figure 5 shows two variations in which varistors have replaced the diodes.

Now, a varistor cannot truly rectify. This was pointed out in an article about varistors and thermistors in the November, 1971 issue of ELECTRONIC SERVICING. But DC voltage **is** produced in one of these circuits **when** the input voltage is a non-symmetrical waveform, such as a pulse. Polarity of the DC voltage depends on the polarity of the pulse. A positive-going pulse produces a negative voltage.

Next month, I will explain the pulse-load regulator and other regulators used in transistor color chassis. □

Why RCA XL-100's can be a quick fix:



RCA XL-100's are 100% solid state, with 12 plug-in, solid state AccuCircuit modules—like the ceramic kine drive amplifier you see above.

Since each of the 12 modules performs specific functions, diagnosis of the trouble is usually quick and easy. Most malfunctions can be fixed right in the home. That's bound to please your customer.

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RF Carriers That Hitch-Hike

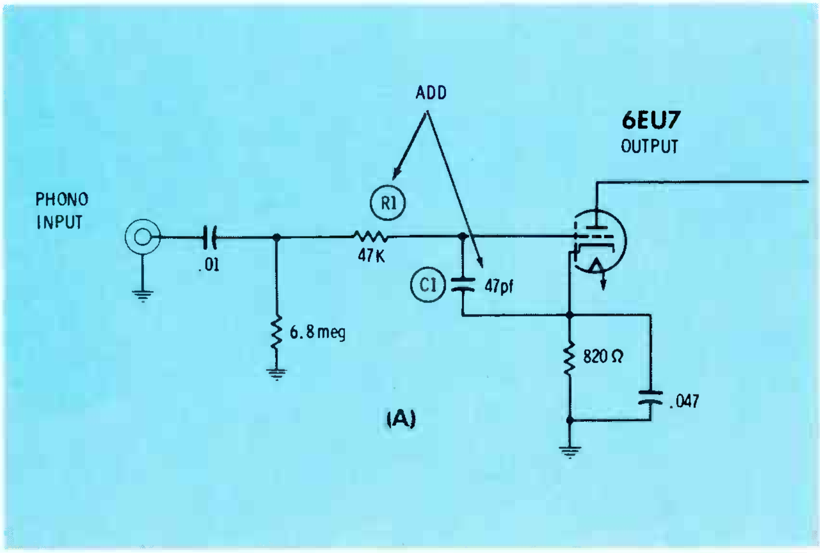
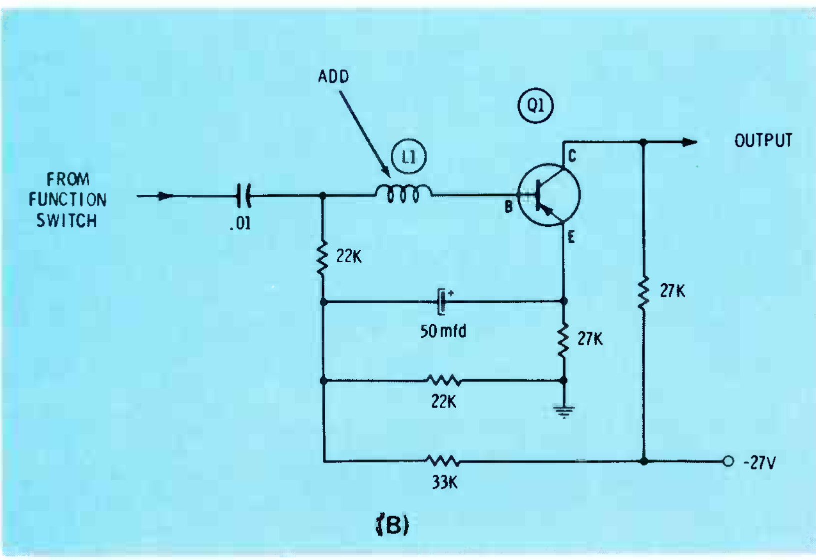


Fig. 1 Add these low-pass filters to tube or transistor audio stages to reduce the RF below the point causing demodulation. **(A)** Values to add to the grid circuit of a tube. Use very short leads. **(B)** Add an RF choke in the base circuit of a transistor used as an audio amplifier. Use the smallest inductance which will eliminate the interference, and shorten the leads of the inductor. In this circuit, capacitances are not very effective and resistors change the bias.



By Jack Gamble

"Car 42 following stolen car north on Oak Street near 11th. Alert North Kansas City to block the ASB Bridge. 10-4." Nothing unusual about such a routine call from a police car. Except that it boomed from the speakers of an electronic organ during the concluding minutes of a pastor's sermon in church! The congregation probably remembered that sermon longer than most.

This is just one example of the many ways radio carriers become unwanted "hitch-hikers" on an audio channel or another carrier. Interfering carriers can enter TV receivers, radios, record players, tape recorders, telephones, public-address systems, intercoms, and yes, even electronic organs at many different points. The visible or audible effects of the interference might produce any one of dozens of different symptoms. In fact, it is extremely difficult, in many cases, to determine whether the symptoms are caused by external carriers or an internal defect in the equipment.

Basic Causes of Interference

These are the most common causes of interference:

- Insufficient selectivity in the receiver which permits two carriers of nearly the same frequency to be seen or heard simultaneously. For example, a weak channel 10 station and a strong channel 9 station will be seen together on channel 10.
- The stations might be "images". That is, one is **higher** than the oscillator frequency by the amount of the intermediate

frequency, and the other is **lower** by the amount of the intermediate frequency. For example, an AM broadcast-band station at 1000 KHz and a receiver IF frequency of 455 KHz would have an image at 1910 KHz. The amplitude of the image is reduced only by the tuned circuits preceding the oscillator.
- Excessive amplitude of the interfering carrier, or an abnormally non-linear stage (or both conditions together) can produce an unwanted heterodyning effect, or it can cause non-linearity and demodulation in an audio stage. These are the conditions emphasized in this article.

The hitch-hiking (or parasitic) carriers can interfere with the desired signal in two main ways:
- Modulation of the parasitic carrier might be added to the modulation of the desired carrier. This is called "cross-modulation".
- The two carriers might mix to form other carriers of sum-and-difference frequencies. These extra carriers usually have the modulation of both the parent carriers. This is called "intermodulation".

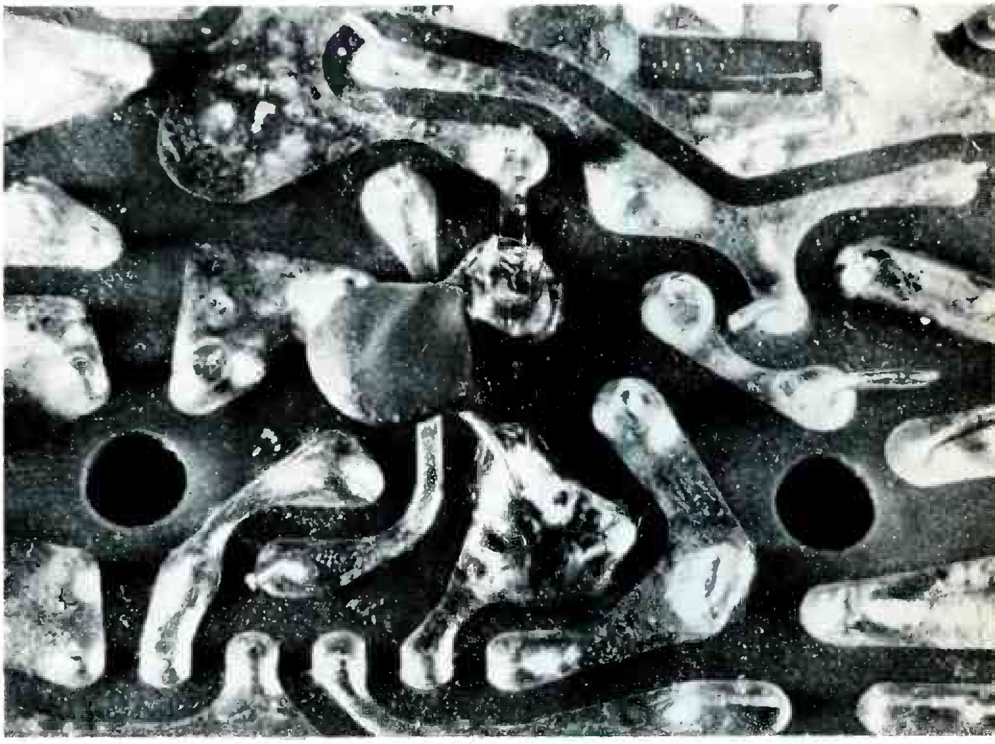


Fig. 2 Wire the added capacitor point-to-point, and shorten the length of the leads as shown.

Audible Symptoms of External Interference

Unwanted signals from amplitude-modulated (AM) stations often are clear and can be identified by the announcements. Single-sideband signals produce an unreadable gibberish. Frequency-modulated carriers might make erratic swishing noises, or they might be demodulated by slope-detection so they can be understood. Rotating radar antennas can produce a "beep" with each revolution. The video carrier of a TV station sounds with a 60-Hz raw buzz. However, the buzz changes with the scene being broadcast, and this might make identification possible by comparing the changes of the buzz to the scene changes of the picture on a monitor TV receiver that is tuned consecutively to the various channels.

Visual Symptoms of External Interference

Interferences by another carrier in the picture of a TV receiver usually take the form of hum patterns or unstable figure "S" patterns similar to those caused by diathermy machines. The figure "S" patterns can appear in either the b-w or color parts of the picture, depending on the frequency.

Because cures for visual interferences were stressed in an article starting on page 50 in the April, 1972 issue of ELECTRONIC SERVICING, we will direct most of the emphasis in this article towards audible interferences, and particularly those originating in the audio stages.

Determining Where The Interference Enters

The first step in eliminating external interference is to determine whether it enters an audio stage following the volume control or enters before the volume control.

Listen for sounds of the interference and rapidly turn down the volume control. Notice which of these two conditions is true:
- If the sounds of the interference and the desired sound both are missing, the signal is entering **before** the volume control. Additional tests are necessary to find whether the interference is entering through the antenna system or by direct pickup in the tuner of IF's.

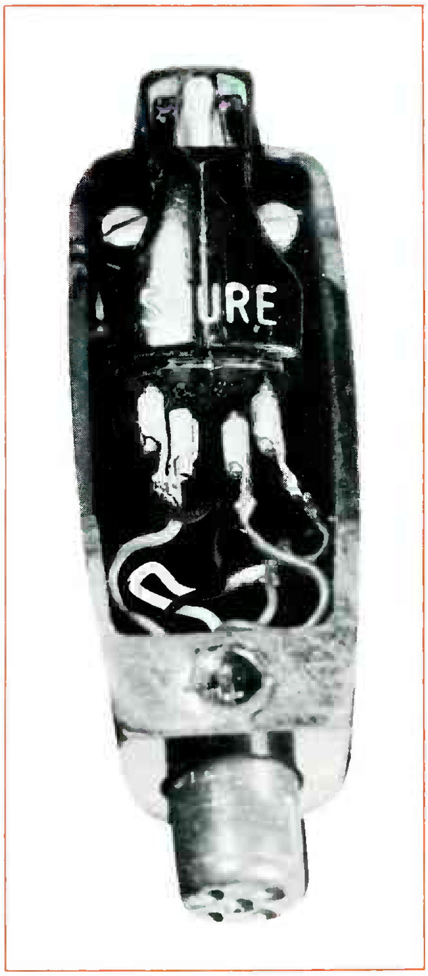


Fig. 3 The wires inside the head of the cartridge, or the leads between cartridge and chassis can act as a short antenna to bring in interference. Re-position the leads, or disconnect them one at a time, to find the source.

- If the interfering sound remains at full strength and the desired sound is missing, the interference is entering a stage following the volume control.

Completely different remedies are required for these two types of interference.

Interferences Affecting The Audio

All tubes, transistors and IC's are somewhat non-linear. Also, excessive signal levels change the bias to produce non-linear conditions. Therefore, high levels of unwanted amplitude-modulated RF carriers can force an audio amplifier to demodulate. The trick is to eliminate or reduce the level of the interfering signal at the **input** of the stage which is demodulating. Because after the demodulation has occurred, no filtering can remove the demodulated audio from the desired audio.

A sequence of tests to pinpoint the cures for interference which enters an audio stage following the volume control is shown in Chart A.

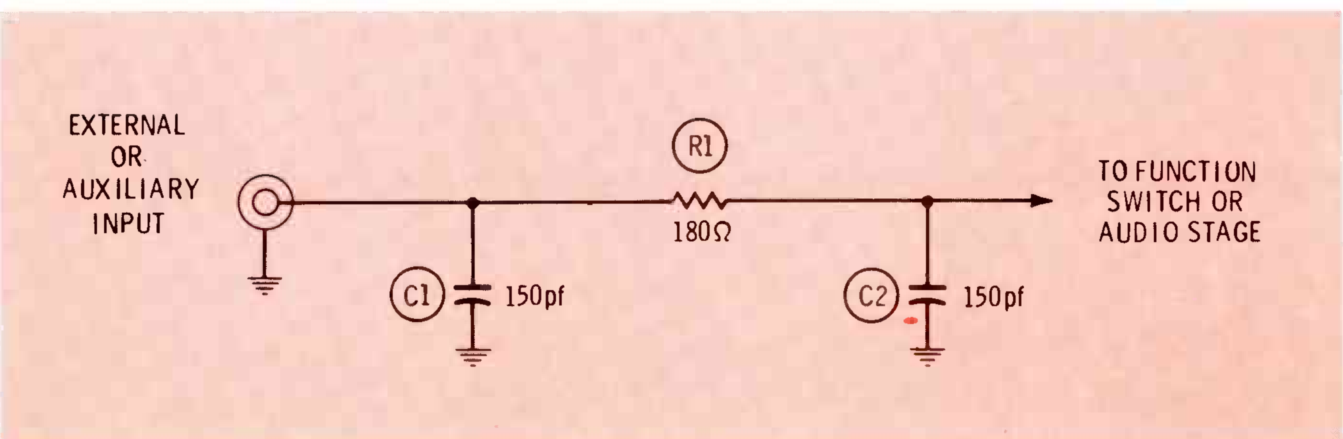
Locate the stage in which the interference first is found. A sensitive scope might be used to locate the stage. Or, locate it by grounding the grids of the tube amplifiers, starting with the first tube and working back toward the output stage. The first grid, which when grounded kills the unwanted sound, indicates the stage where the interference is entering. In transistorized stages, connect together the base and emitter of the transistors.

Next, check the components and voltages in the suspected stage for any abnormality. Even normal amounts of RF will be demodulated if a tube is gassy or has positive or zero bias. Demodulation also can occur if a transistor is defective or has insufficient bias.

If no defect can be found in the offending stage, add the filter components shown in Figs. 1A or 1B. In most cases, addition of these parts will stop the interference. Use short lead lengths as shown in Fig. 2.

However, it is possible for the interfering carrier to be brought with such large amplitude into the chassis through the antenna system, power line or external speaker wires that the "fixes" in the audio stages are not suffi-

Fig. 4 This filter can be added at an input plug which brings in RF interference. Two filters can be used on the input from a ceramic stereo phono cartridge, if the capacitors do not reduce the volume too much.



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cient. In that event, check for the filters listed under the next section.

Tips For Combination Instruments

Interference might be experienced in combination instruments on one function and not on the others. For example, a ham station or other AM signal, might be heard when the phonograph was in use, but not when the AM or FM bands were selected. In that event, the connections to the tone arm (Fig. 3) should be disconnected one by one to find the origin of the interference. If pre-amps are used, filters as shown in Figs. 1A and 1B might be added. Or two filters such as the one in Fig. 4 could be used, one to each of the stereo input plugs.

Here are some general tips about adding filters to phono cartridges:

- Capacitances added in parallel with crystal or ceramic phono cartridges reduce the output signal from the cartridge,
- capacitances added in parallel with dynamic, magnetic or reluctance phono cartridges reduce the high frequencies (the capacitance and the inductance of the cartridge act as a low-pass filter),
- capacitances connected in parallel with the grid circuits of tubes, or inductances connected in series with the bases of transistors, reduce the high-frequency response,
- larger values of filter components are required for low-impedance circuits, and smaller values are required for high-impedance circuits.

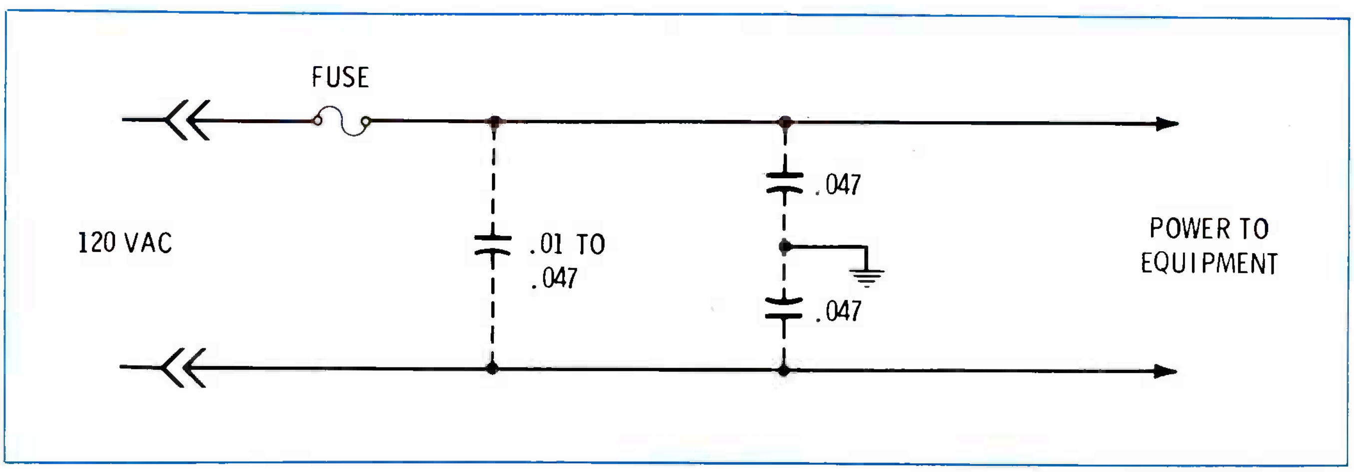
Therefore, do not use values larger than the minimum required to reduce the interference.

Interferences Affecting RF or IF

A sequence for identifying and eliminating interfering carriers which enter through the antenna, or which are picked up by the IF section, is listed in Chart B. Most interferences coming in through the antenna or by direct pickup to the tuner can be changed or eliminated by trying different channels or varying the fine tuning. Those interferences entering through the IF stages usually are not affected by the channel or fine tuning adjustments.

Fig. 5 One brand of high-pass filter used between the downlead and the antenna terminals on the receiver. It is useful in removing frequencies in the IF range and lower.

Fig. 6 Capacitors can be added to the input power plug, if the receiver does not already have them. Use the wiring which most reduces the interference.

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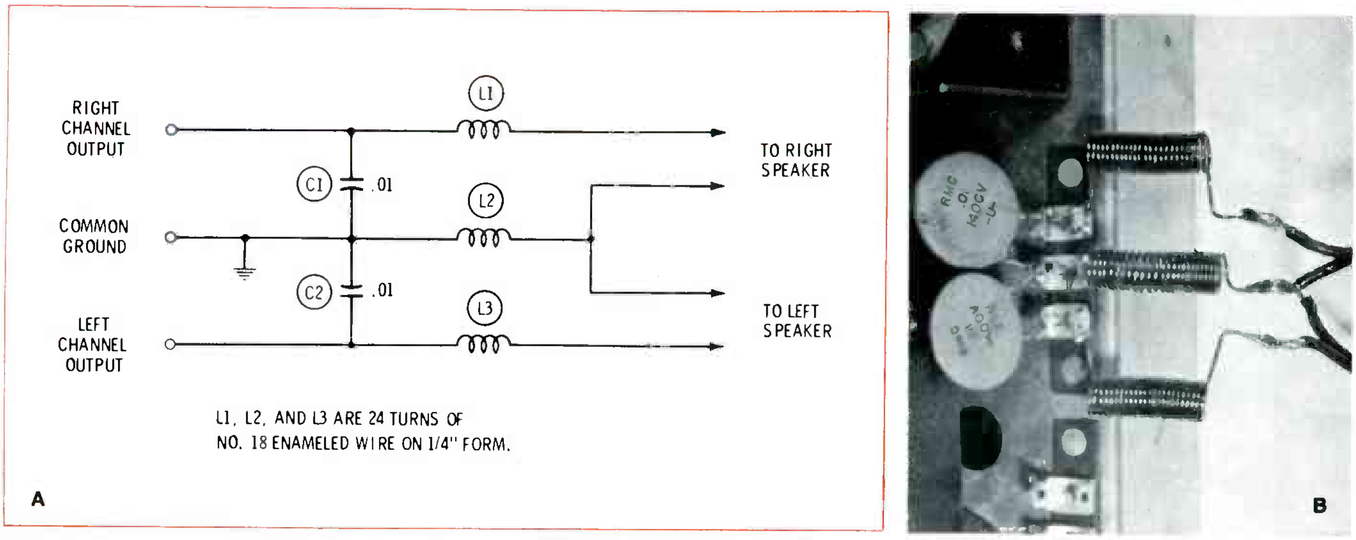


Fig. 7 Picture and schematic of filters to add to external-speaker wires which cause interference. **(A)** Schematic and parts values of the filters. **(B)** Appearance of the completed filters.

Interference from the antenna

If the interference is reduced or eliminated by removal of the download from the antenna terminals of the receiver, a high-pass filter (Fig. 5) should be inserted between the twin lead and the antenna terminals. In extreme cases, it is necessary to install the high-pass filter at the tuner. In fact, the case should be bolted or soldered to the tuner. This is to eliminate the possibility of the twin lead from the rear to the front of the receiver acting as an antenna to bring in interference from the 6-meter amateur band.

Tuned traps sometimes can be used to eliminate an interference that occurs only on one channel. However, you should use caution when such a trap is adjusted, for some tuned-trap adjustments can cause smeared and displaced color.

Interference riding the power line

Some interfering carriers ride into the receiver on the wires of the power line. Plug-in filters consisting of capacitors (or more effective ones with both coils and capacitors) can be installed where the receiver plugs into the wall outlet.

In other cases, additional capacitors or coils must be installed inside the receiver for better rejection of the interference. Two possible connections of capacitors in parallel with the AC input plug are shown in Fig. 6.

Interference can hitch-hike the speaker wires

External-speaker wires running to other rooms can bring in interfering carriers which then are radiated to circuits inside the chassis. A fast test is to disconnect all the external-speaker wires. If the interference is gone, add a home-made filter (Fig. 7) to each external-speaker wire.

Common Sense And Customer Relations

Many cases of interference with TV or radio reception seem to stir up anger and bitterness in the victim. Although this attitude is understandable, it is usually misdirected and harmful. You, as the knowledgeable technician, should attempt to make reasonable explanations while doing the analysis and repairs, for very seldom is the interfering equipment at fault.

The Federal Communications Commission (FCC) rules specify the amount of harmonic and spurious emission permitted by each class of transmitter, or other equipment which incidentally radiates. For example, an amateur operator located very near the victim cannot be blamed for any interference so long as his transmitter is operated within the law. That is, on a legal frequency, within the specified power, and without excessive harmonics or spurious emissions. Although many "hams" will cooperate in eliminating such interference, they are not obligated to do so.

Next, the manufacturer of the TV or radio receiver which exhibits the interference can be blamed by the customer. Perhaps there is a grain of justification here. However, no one "fix" or combination can be guaranteed to eliminate all interference from all locations. Therefore, a manufacturer usually is not morally or legally responsible for the interference beyond producing equipment which is standard to the "state of the art". Despite these limitations, many manufacturers will give suggestions or other help in these situations, if they are informed of all the facts.

In general, a technician will emerge from cases of interference-elimination in a more favorable position if he acts as a peacemaker who also finds and eliminates the source of the problem. □

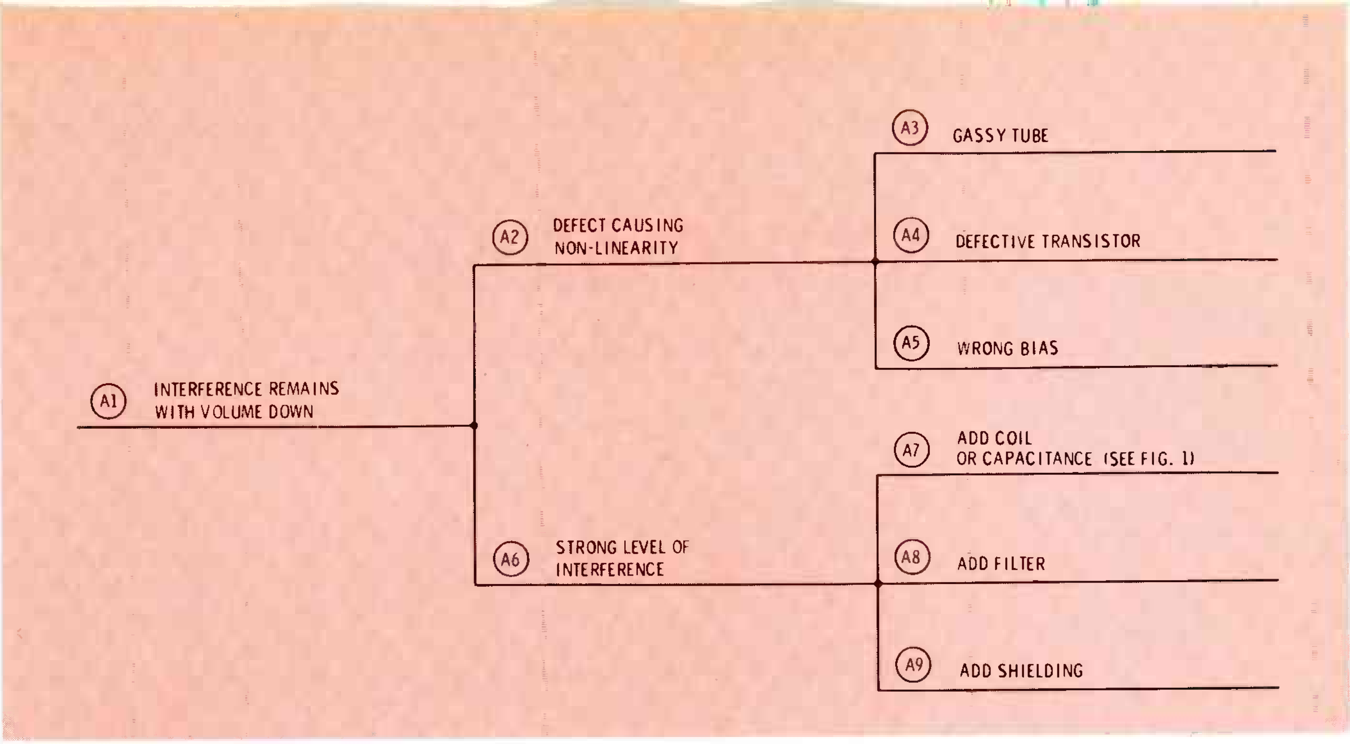
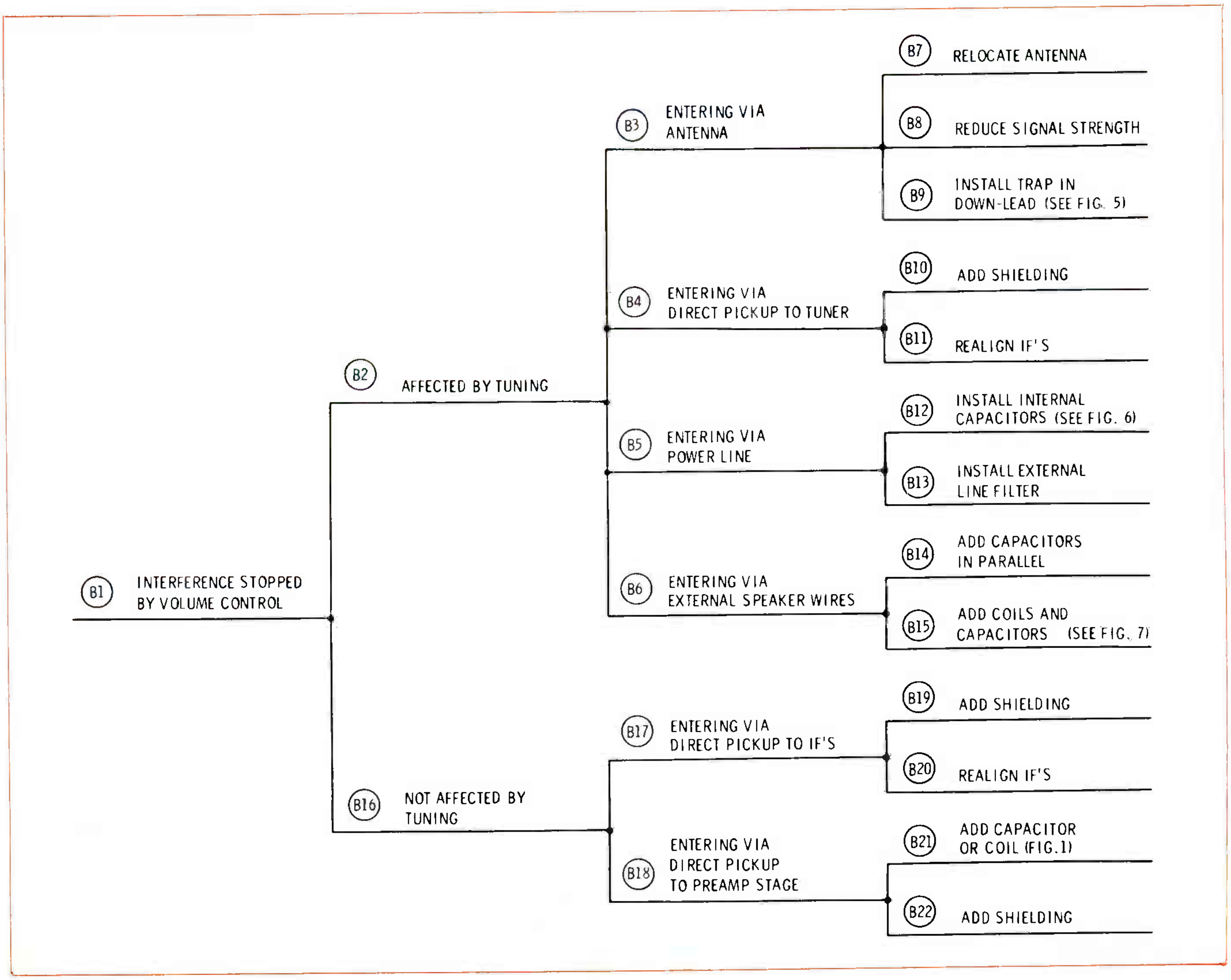


Chart A Steps for locating or eliminating external interference which enters an audio stage and is demodulated by non-linearity or excessive amplitude of the interference.

Chart B Steps to locate or eliminate interference which enters a receiver through the antenna leads or is directly picked up by the tuner, IF's or any circuit before the volume control.



MATV Systems

By John Rogerson/Technical Director, MATV Channel Master Division of AVNET, Inc.

■ A four-part series about master antenna television (MATV) systems.

1) System Components
2) Decibels
3) Designing The Distribution System
4) Designing The Head End

Sections Of A MATV System

Any master antenna system consists of two main sections: the **head end** and the **distribution system.**

The head end usually includes the antenna installation, (to receive the desired signals) and the amplifiers, (to increase the signals to a usable level). A well-designed distribution system is required to deliver an adequate signal to all TV sets in the system.

First Design The Distribution System

Because there are more possible variations in the design of antenna systems in the head end, the distributing system should be designed first.

The first step is to obtain plans of the building, or make rough layouts of the structure, and mark on them the locations of all necessary TV outlets. Also choose a central location for the amplifiers.

You must decide whether the distribution cables to the individual TV's are to be run horizontally or vertically. Usually, if the building is taller than it is wide, the cables should run vertically. Or run the cables horizontally if the building is wider than tall.

Next determine the number of cable runs necessary to supply every set in the system. Avoid long runs wherever possible—two 400 foot runs are usually better than one 800 foot run—for example. Cable runs should be as straight as possible. Avoid zig-zag runs and loops. After the distribution cable runs have been determined, mark the location of each tapoff and splitter.

Use the longest cable run, or the one with the largest number of splitters and tapoffs, to calculate the losses of the system. In other words, use the branch with the greatest total loss, because this equals the losses of the system. If you are in doubt as to which branch has the highest loss, calculate the losses on several branches to find the one with

Chart 1 The nominal attenuation of the signal in dB's per 100 feet of various types of 75-ohm coax cable listed for typical TV channels.

Courtesy of Channel Master

CABLE CHARACTERISTICS

NOMINAL ATTENUATION dB PER 100 FEET

CABLE	Ch. 2	Ch.6	Ch. 7	Ch. 13	Ch. 20	Ch. 30	Ch. 40	Ch. 50	Ch. 60	Ch. 70	Ch. 83
Color Duct	2.3	2.7	3.8	4.2	6.5	7.0	7.5	7.8	8.0	8.4	9.0
Foam Color Duct	2.1	2.5	3.3	3.8	5.9	6.3	6.7	7.0	7.3	7.7	8.0
RG 59/U	2.6	3.5	4.9	5.4	8.3	8.8	9.2	9.7	10.3	11.0	11.9
RG 59/U Foam	2.3	2.7	3.8	4.2	6.2	6.6	6.8	7.1	7.3	7.7	8.0
RG 11/U	1.4	1.7	2.2	3.2	5.1	5.3	5.5	5.7	6.1	6.2	6.8
RG 11/U Foam	1.1	1.4	1.6	2.3	3.9	4.0	4.1	4.2	4.4	4.6	4.9
.412	.74	1.0	1.4	1.5	2.5	2.6	2.7	2.9	3.1	3.3	3.5

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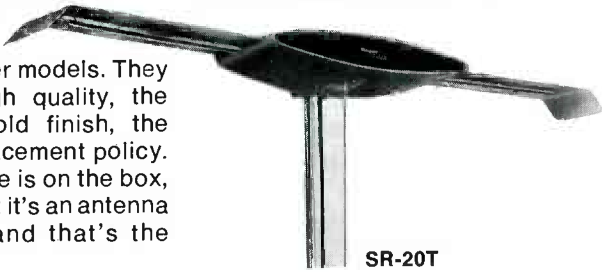

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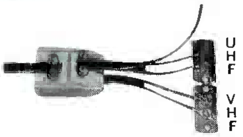

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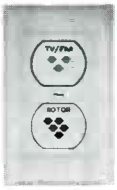

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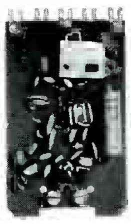

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TELEVISION SYSTEMS

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the greatest loss.

In general, there are four types of loss that must be considered. These losses are:

- cable loss,
- splitter loss,
- insertion loss, and
- isolation loss.

Cable loss

A certain amount of signal will be lost as it travels through a coaxial cable. This loss is dependent on two factors: the type of cable used, and the frequency of the signal.

Losses are greater at higher frequencies, with the greatest loss occurring at the frequency of channel 13 on VHF or channel 83 in a VHF/UHF system. Always figure the cable loss at the frequency of channel 13 in a VHF system, and the frequency of the highest UHF channel to be received, if the system includes UHF. Refer to Chart 1 for the nominal attenuation per 100 feet of various types of coax cable.

Splitter loss

When a two-way splitter is inserted in the line, the signal in each branch leg will be approximately 3.5 dB less than that of the line. If a four-way splitter is inserted in the main line, the signal in each branch leg is about 6.5 dB less than that in the main line.

For example, an input of 30 dB to a splitter provides a signal of 30 dB less 3.5 dB splitter loss (or 26.5 dB) to each of two branches.

Insertion loss

All tapoff devices inserted into the distribution system create signal loss. This is known as the insertion loss of the device. Sometimes it is called feed-through loss. Notice that it is a loss to the entire system which follows, and should not be confused with the losses introduced deliberately by the isolation tapoffs or signal-reduction pads.

If 10 tapoffs are used and each has an insertion loss of .5 dB, the total insertion loss is 5 dB.

Because the output of the amplifier influences the final selection of tapoff values, the tapoff values should first be estimated.

These are typical insertion losses of isolation-type wall taps:

- 23 dB isolation—.3 dB,
- 17 dB isolation—.7 dB, and
- 12 dB isolation—.9 dB.

Isolation loss

To prevent one receiver from interfering with another, each tapoff also attenuates (by a specified number of dB's) the signal from the line. For example, if there is 25 dB of signal in the line, a 23 dB isolation wall tapoff reduces the signal at the receiver to 2 dB.

Compute the total losses of the distributing system by figuring only the isolation loss of the last tapoff. It is more economical at that point to use the lowest isolation value of 12 dB because less signal is required in the line.

Selecting tapoff values

The object of selecting tapoff values is to use taps that will deliver a 0 dBmV (1000 microvolts) signal to each set in the system, and provide isolation enough to prevent interference.

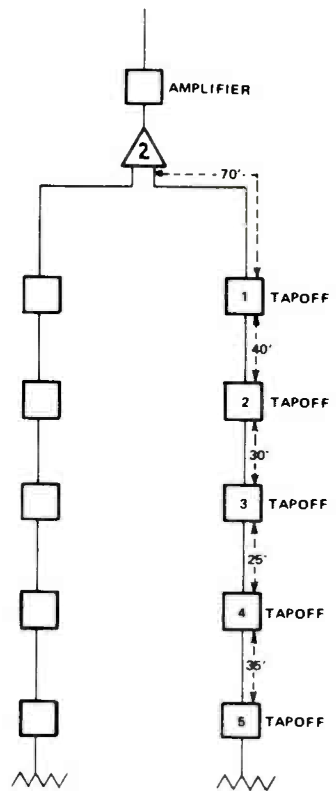
No receiver should receive less than 1000 microvolts on each active channel. If the signals are strong in the area and there is a possibility of direct-signal pickup, 2000 microvolts (or more) should be supplied from each tapoff. To provide extra insurance against ghosting, many professional MATV engineers compute their systems to provide 10,000 microvolts at each tap.

The higher the isolation value of the tap, the lower the insertion loss. Of course, the insertion loss is small compared to its isolation value, but the isolation loss applies only to one receiver while the insertion losses of all tapoffs in the system must be added together.

If there is a long cable run between the tapoff and the receiver, the loss of the cable must be added to the isolation loss. Cable from a wall tap to a receiver has so little loss it can be disregarded.

Calculating Isolation Values

An example of a VHF distributing system is charted in Fig. 1. The losses must be calculated step-by-step to determine the isolation values at each tapoff, and finally the requirements of the head end.



Our system's losses tally as follow:

Cable Loss	8.4 dB
Splitter Loss	3.5 dB
Insertion Loss	3.5 dB
Isolation	12 dB
Total System Losses	27.4 dB

Fig. 1 Helpful drawing of a simple MATV distribution system having two identical branches which is used to determine the approximate total loss of the system.

This system has two equal branches. In a system with unequal branches, we would figure the head end requirements based on the branch with the largest losses.

The first step is to determine the losses of the total system. That is, the losses of cable, splitter, insertion and isolation.

Cable loss

Assuming that we are using a low-loss, 82-channel coaxial cable (such as Channel Master Duct-82 which has losses of approximately 4.2 dB per 100 feet at the frequency of channel 13), the total attenuation for the 200 feet

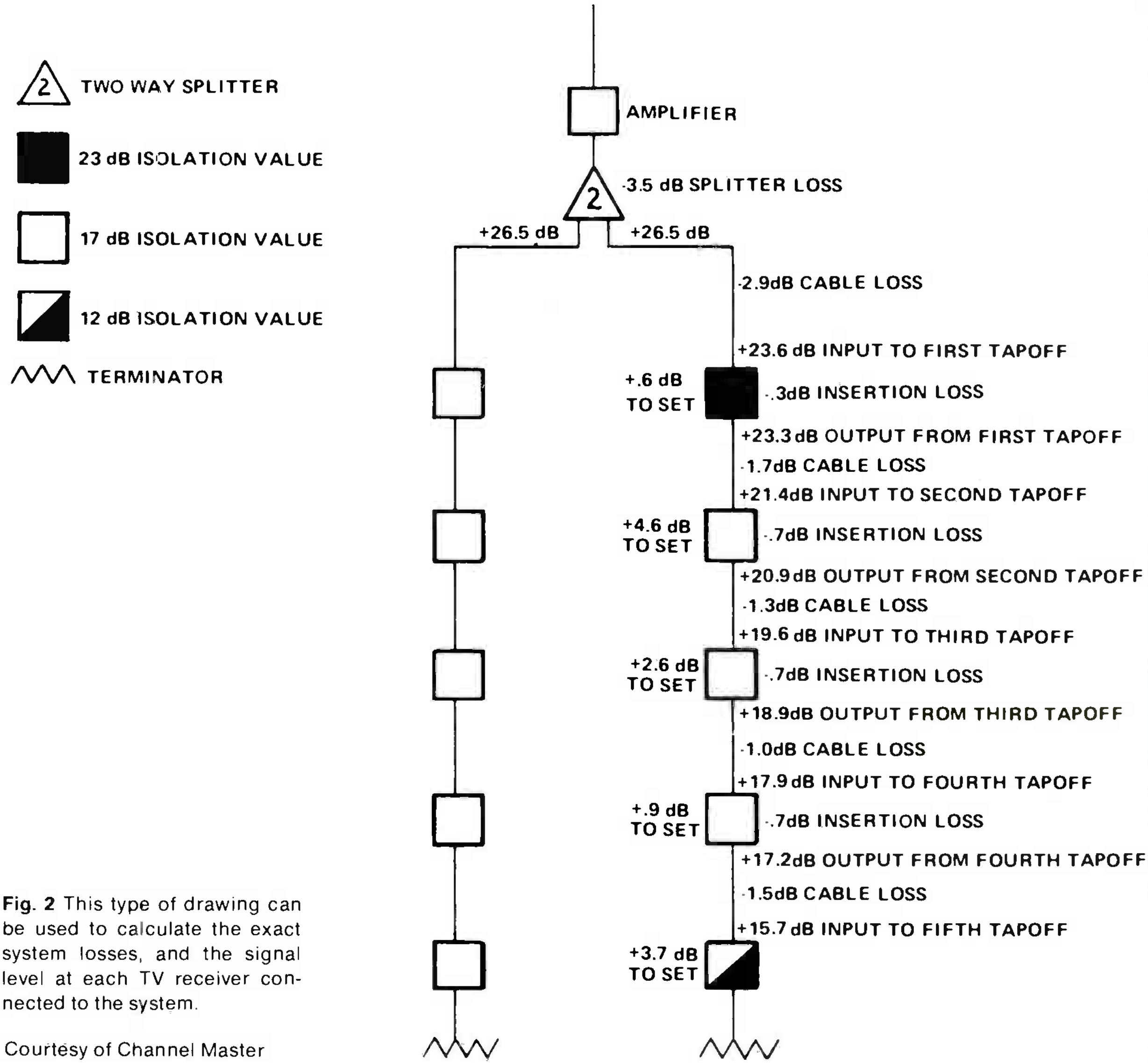


Fig. 2 This type of drawing can be used to calculate the exact system losses, and the signal level at each TV receiver connected to the system.

Courtesy of Channel Master

of cable used in one branch is 8.4 dB.

Splitter loss

Loss in the one splitter is 3.5 dB.

Insertion loss

At this time, the losses should be estimated using the values for 17 dB insertion loss. This is .7 dB per tapoff which multiplied by 5 tapoffs equals 3.5 dB.

Isolation

For purposes of signal economy, we will use a value of 12 dB for the isolation value of the final tapoff.

Calculation

Add together all of the individual losses this way:

cable loss	8.4 dB
splitter loss	3.5 dB
insertion loss	3.5 dB
isolation loss	12.0 dB
Total system losses	27.4 dB

Therefore, the head end must deliver at least 28 dB of signal to overcome the losses of the system and supply a minimum of 0 dB to the last receiver on the line.

It is good practice to allow an extra 6 dB in output from the amplifier to allow for any loss of gain over a period of time. Because this additional 6 dB is reserve, it is not included in the calculations.

Exact isolation values of each tapoff

Now that the requirements of the head end have been determined, we can select the isolation values of each tapoff, bearing in mind that each receiver must receive at least 0 dB of signal.

One rule-of-thumb for selecting isolation values is to use the highest value possible so insertion losses are minimized. For example, where signals are stronger than 23 dB, we use 23 dB isolation at the tapoff. Where signals are lower than 23 dB but greater than 17 dB, we use 17 dB isolation, etc.

Signals at the distribution amplifier

Because the losses of the system are 27.4 dB, we will assume the use of an amplifier with an input signal level of 0 dB and having 30 dB gain.

After the splitter, the signal will be 30 dB minus 3.5 dB, or 26.5 dB. If an appreciable length of cable is used to connect the amplifier and splitter, the loss of the cable must be calculated.

Signal at the first tapoff

The 26.5 dB of signal from the splitter must pass through 70 feet of cable to reach the first tapoff. Seventy feet of cable with an attenuation of 4.2 dB per hundred feet causes a loss of 2.9 dB. So, 26.5 dB minus 2.9 dB leaves 23.6 dB at the input of the first tapoff.

An isolation value of 23 dB for the first tapoff leaves .6 dB (which is more than the required 0 dB) at the first receiver.

From 23.6 dB must be subtracted the insertion loss of .3 dB. So the output from the first tapoff is 23.3 dB.

Signal at the second tapoff

Attenuation of 40 feet of cable to the second tapoff is 1.7 dB. Therefore, the signal at the input of the second tapoff is 23.3 dB minus 1.7 dB, or 21.6 dB. A 17 dB isolation value should be used, and this value subtracted from 21.6 dB leaves 4.6 dB for the receiver.

The 21.6 dB signal at the input of the second tapoff is reduced by the .7 insertion loss of the 17 dB isolation tapoff, and this leaves 20.9 dB at the output.

Signal at the third tapoff

Attenuation of the 30 feet of cable to the third tapoff is 1.3 dB, and this value subtracted from 20.9 gives 19.6 dB at the input of the third tapoff.

A 17 dB isolation tapoff subtracted from 19.6 dB reduces the signal at the third receiver to 2.6 dB. This is well above the minimum required.

The 19.6 signal at the input of the third tapoff is reduced by the .7 dB insertion loss of the 17 dB isolation tapoff. Remaining at the output is 18.9 dB.

Signal at the fourth tapoff

Attenuation of the 25 feet of cable to the fourth tapoff is 1.0 dB, which subtracted from 18.9 dB gives 17.9 dB at the input of the fourth tapoff.

A 17 dB isolation tapoff subtracted from 17.9 dB leaves .9 dB for the fourth receiver; this is above the minimum required.

The 17.9 dB signal is reduced by the .7 dB insertion loss of the 17 dB isolation tapoff to allow a 17.2 dB signal at the output of the fourth tapoff.

Signal at the fifth tapoff

Attenuation of the 35 feet of cable to the fifth tapoff is 1.5 dB, which subtracted from 17.2 dB leaves 15.7 dB signal at the input of the fifth tapoff.

A 12 dB isolation tapoff must be used here, because a 17 dB value would reduce the signal below the 0 dB mark. The 12 dB subtracted from 15.7 dB leaves 3.7 dB, which is more than enough signal for the fifth TV receiver.

Use a terminating load resistor

A 75-ohm terminating load must be connected at the output of the last tapoff in each branch. Without the termination, reflected signals cause smeared and ghosty pictures.

Designing the other branch

In this example, the other branch had the same number of tapoffs and the same cable lengths, therefore, the same calculation applies to the other branch.

Example in chart form

All of the previous information can be condensed conveniently into a chart, as shown in Fig. 2. Such a chart should be prepared for each non-identical branch of the system.

Next Month

Design and calculation of the head end of MATV systems will be featured in part 4. □

TYPICAL DEFECTS IN AUTO TAPE PLAYERS

About 80% of a technician's time is required to cure typical defects in auto tape players. Use these tips to increase your shop production with less work. **By Joseph J. Carr**

This month, we are taking a look at some of the more common mechanical and electromechanical problems encountered in servicing automotive tape players. However, the similarity to troubles in the home units make these examples useful even if you limit your servicing to home machines.

Typical Problem No. 1

The complaint is that **the music drags, or the tape runs slow.** This trouble is almost classic because it affects virtually all tape players and all tape formats. It is likely you will find the machine either is old or has been used more than normal. The most frequent cause of drag is lack of cleaning.

Standard tapes use an iron oxide on one side and a graphite lubricant on the other. Both of these materials tend to flake off. And when this flaking occurs for a long enough time, a large amount of oxide and graphite builds up on various surfaces of the player mechanism.

Figure 1 shows the drive mechanism of a typical tape player. A rubber belt supplies power to the flywheel. Concentric to the flywheel is the capstan which drives the tape. The capstan rides in a sleeve-bearing capstan housing, and the spacing is narrow. It doesn't take much oxide build-up to cause binding.

For proper cleaning, the flywheel/capstan assembly must be removed from the sleeve bearing. Use either pipe cleaners or cotton swabs which have been soaked in an appropriate solvent to remove the iron oxide and graphite slime from the bearings. Be sure to clean all surfaces. In some cases, an improper cleaning job can be caused by a technician who forgets that the top of a sleeve bearing also has an underside!

It is necessary also to clean the flywheel and capstan. For this operation, paper towels have proven best. Clean the flywheel and bearing surfaces with a good solvent. Ampex, or other brands of commercial cleaner, will be suitable. A good substitute at one-tenth the price is old-fashioned isopropyl alcohol. Despite it's fancy name, this is none other

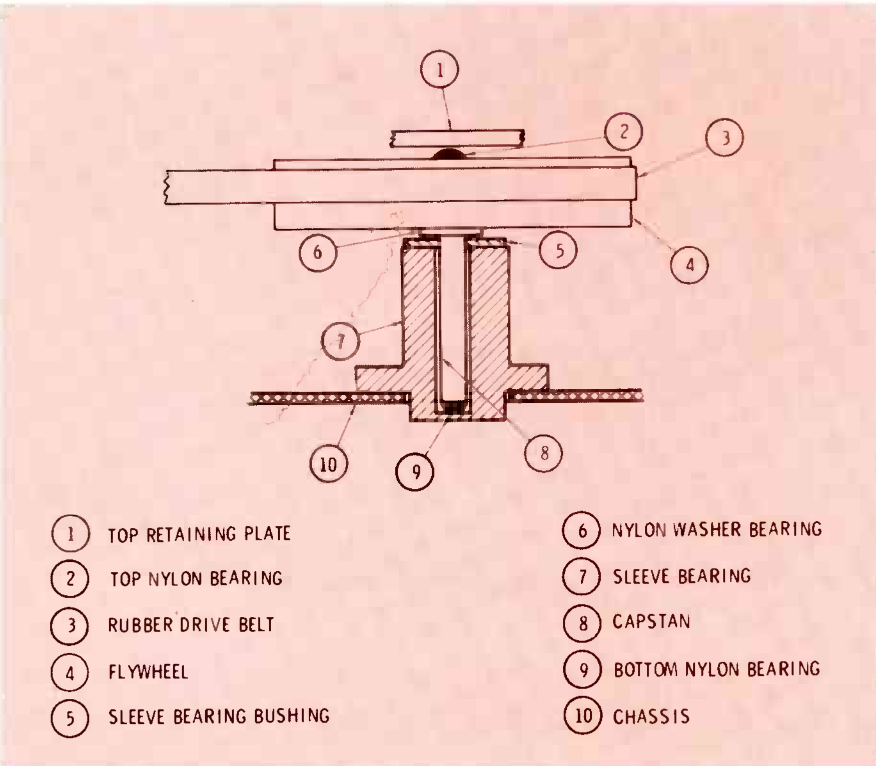


Fig. 1 A typical tape-drive system used in eight-track players. Clean all bearing surfaces and inspect the nylon-tip bearing at the bottom of the capstan.

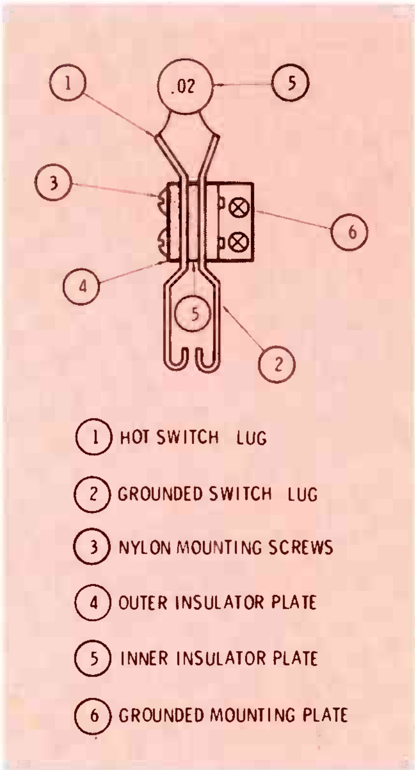


Fig. 2 An automatic track change switch. Loose screws or oxide fouling can become problems.

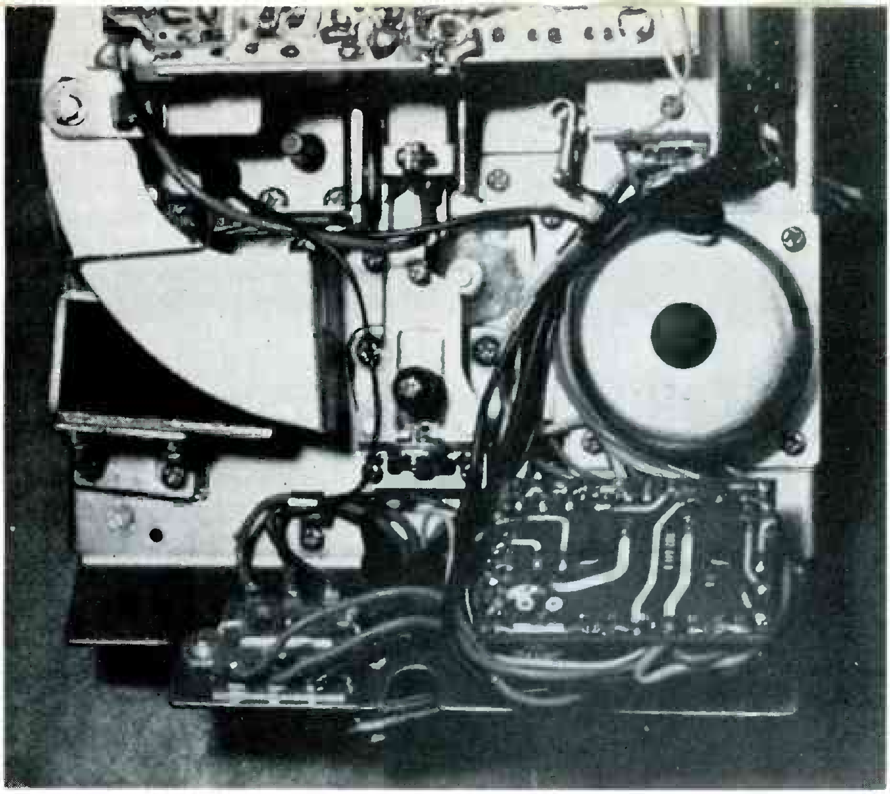


Fig. 3 Photo of Craig Model 3125 electromagnet pinch-arm mechanism. Adjusting the position of the magnet allows the player to use off-brand tapes.

than two-bits-per-pint rubbing alcohol. Even better, when it is available, is another kind of alcohol. This superior type is the kind sometimes used in people: grain alcohol.

While the flywheel-capstan assembly is out of its housing, inspect the nylon-tipped bearing at the bottom of the capstan shaft. These bearings tend to wear out after a period of time. If the nylon bearing is found to be worn, it should be replaced . . . for it can be the source of a maddening form of wow produced when the capstan shaft rides up and down across the tape surface.

It is also a good idea to replace the rubber drive belt when you clean the player. This is good preventive maintenance. Belt replacement is standard procedure in most tape shops because it results in a lower-than-average callback rate. Many technicians feel that one out of three comebacks are due to problems traceable to a defective belt.

One last note before moving on to the next case: Be very stingy with your lubricant. Excessive lubrication can cause slippage and ruin tape. One drop of 3-in-1 oil, or one dab of white grease at the bottom bearing should prove sufficient. Lubricate other points only if specifically instructed to do so by the manufacturer's data.

Typical Problem No. 2

The customer might complain that his **machine will not change tracks.** This case also involves cleaning. Oxide fouling of the player's automatic track-change switch might be the cause. One example of a track-change switch is in Fig. 2. The sense elements are a pair of metal tangs that project into the eight-track cartridge. The metal foil that splices together the ends of the tape passes over these tangs and shorts them together. This grounds the coil of the solenoid that operates the track-change cam. There are two separate problems associated with oxide-fouling of the sense elements. If the oxide coats the active surface of the tangs (the usual case), there will be too much resistance to allow enough current to pull-in the solenoid. This causes the solenoid to "half step" the cam, and often jams the solenoid-cam assembly.

The other type of trouble occurs when the oxide builds up between the two tangs. The oxide acts as a resistor and allows a permanent current to flow in the solenoid windings. If the current is heavy enough, the solenoid will pull in partially and jam the cam. Since the solenoid duty cycle should be short, this overload might burn out the winding.

Typical Problem No. 3

A common complaint on machines using the track-change switch illustrated in Fig. 2 is that **it changes tracks all by itself** when the car bounces over rough spots in the road. A loose TC switch assembly is the usual cause. The screws holding the pieces together are made of nylon. If they are tightened too much, they can develop a fracture and eventually break. When this occurs, the metal tangs are loosened and might short together. The defect happens often enough to justify ordering a supply of nylon screws from one or more tape-player manufacturers. They all seem to use the same size, so one order will serve for all.

Typical Problem No. 4

The customer says his **machine will not play certain brands of cartridges.** In the early days of eight track, only a few basic types of cartridges were used. But now there are many types, and some of these are none too good. In most cases where the pinch arm in the player is of a fixed design, there is no fix.

If, on the other hand, the pinch arm is adjustable, you might find a compromise point where the machine will play most types of cartridges. Machines that use either an electrical- or mechanical-eject mechanism usually can be adjusted. Figure 3 is a picture of such a machine; the Craig Model 3125 floor-mount model. The pinch arm is held in place by an electromagnet and the position of the magnet is critical. Try adjusting the magnet using tapes belonging to the customer. This usually will be one of the types that have a plastic pinch roller, and instead of a spring pressure-pad assembly, a strip of foam rubber. If you are careful, the adjustment should allow the machine to play these cheaper ones as well as the normal Lear-type cartridges.

If a machine will play all except one particular cartridge, examine the pressure pad in the cartridge. If it is of the foam rubber-strip variety, then little can be done. But, on the other hand, if it is of the spring and cotton-pad type you might be able to help. Increase the pad pressure by bending outward the spring leaves.

Jammed or dragging eight-track and cassette cartridges can sometimes be cured by lightly rapping the cartridge against a hard surface such as a workbench or counter top. In the case of eight-track cartridges, occasionally you can fix a drag problem by manipulating the tape. Using a non-magnetic tool (an IF alignment tool works great) pull some tape out of the cartridge at the pinch-roller slot. Continue pulling the tape until you feel it bind. This will result in a loop of tape usually a foot or so long hanging out of the cartridge at the pinch-roller slot. Grasp the tape between your thumb and index finger at the point where it exits closest to the center of the cartridge. Do not grasp both leaders; only the one closest to the cartridge center. Invert the cartridge and give the tape a sharp jerking motion, then release quickly. The tape should be snapped back inside the cartridge by its own inertia. This will sometimes repair a jammed cartridge that otherwise would be useless. This procedure does, however, involve a risk: You might break the tape. Be sure the customer understands the danger and accepts responsibility for the cartridge.

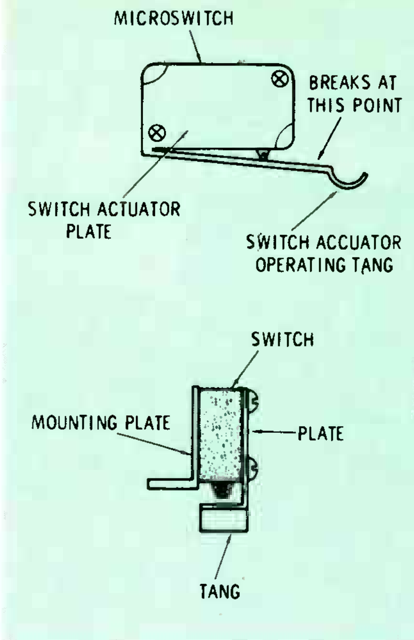


Fig. 4 The actuator tang on this power switch often breaks creating symptoms similar to those caused by an open power switch.

Typical Problem No. 5

In many cases, **the tape player will not turn on when a tape cartridge is inserted.** This might be due either to an open switch or a broken power-switch actuator tang. See Fig. 4. The actuator is a spring-metal affair that is attached to the body of the microswitch. It is somewhat flimsy and tends to break off easily. Fortunately, only a few types of actuators are in common use. You can stock a working quantity of all types for less than five dollars.

There is one type of tape-player deck sold by many importers (including certain of the large national mail-order department stores) that use two of these actuator tangs. One, which operates the audio amplifier power supply, is located where it is easily accessible. The other operates the motor and is located where only removal of a printed-circuit board will allow access. As bad luck often will have it, the switch actuator located in the easy position never breaks while the other breaks frequently.

Typical Problem No. 6

Cassette players often spill tape, most frequently because of a lack of take-up tension. There are two forces dragging the tape across the head. One is the pinch-roller and capstan, while the other is the rotation of the take-up reel. Fig. 5 shows two common take-up reel drives. The drive system, in Fig. 5A, is used by the Automatic Radio Model ACS-6000. In this system, the drive idler is powered from the main flywheel by a secondary drive belt.

The type of drive common to the Ampex Micro-40 series, the Gibbs 900 series, and many other similarly-designed decks is shown in Fig. 5B. In these machines, a small idler runs against a larger intermediate idler (not shown) that in turn, runs against the capstan.

Players using the system of Fig. 5A will frequently lose take-up tension because of undercutting by the idler of the rubber tire. This can be repaired without

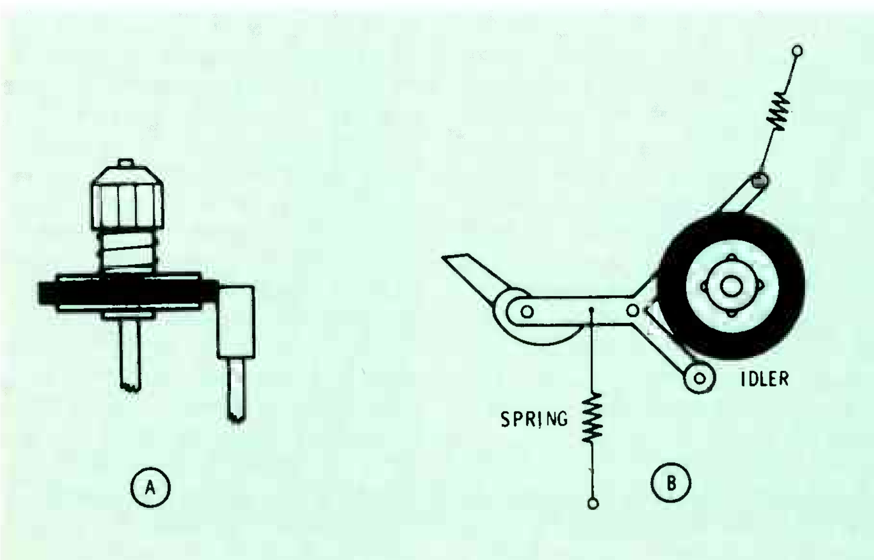


Fig. 5 Two popular cassette take-up-reel drive systems. In either case, a loss of take-up tension results in tape spills and breakage.

removing the reel simply by replacing the worn tire. On players using the system of Fig. 5B, a most frequent cause of low tension is deterioration of one or both power springs. Replacement springs are available. It probably will be a waste of time trying to use a substitute spring, as the tension is critical.

Other causes of spill include excessive pinch-roller pressure and, surprisingly, too much take-up reel tension. Improper pinch-roller pressure is cured by relocating the spring that supplies this pressure. The other cause, too much take-up tension, is caused by defective clutch facings on the take-up reel assembly. The cure for this is either a new assembly or a new clutch, whichever is available.

Typical Problem No. 7

The player ejects the cassette 10 seconds after insertion. Most of the Staar-system cassette players used in automotive service include an end-of-play sensor to eject the cassette when it has finished playing. Most sensors are driven by the supply reel. A very common type is illustrated in Fig. 6. It is merely a pair of switch contacts operated by a cam driven from the supply reel. Output of the sensor is a square wave of about one Hertz in frequency and seven volts peak-to-peak in amplitude. This squarewave is fed to an emitter-follower amplifier circuit and then to a voltage doubler consisting of D1, D2, C1 and C2. When the supply reel stops turning there will be either a high-voltage level or zero volts at the input to the amplifier.

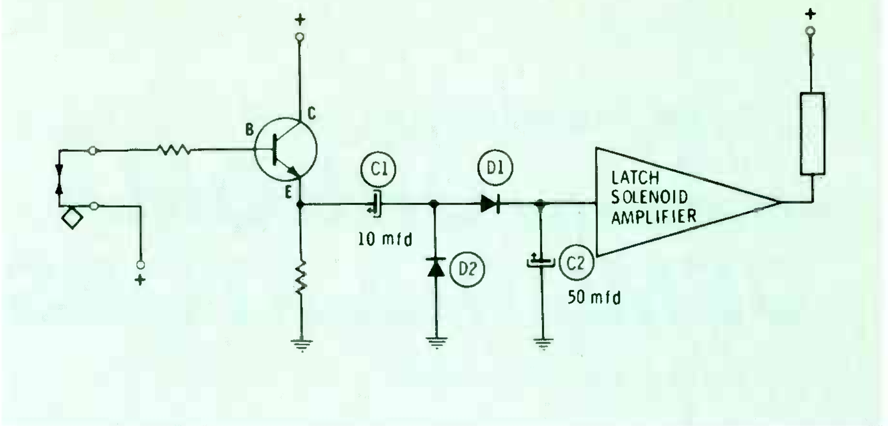


Fig. 6 This automatic end-of-play eject circuit responds to squarewaves generated by a simple sensor attached to the supply reel.

In either case, the lack of a **changing** level will cause C1 to cease feeding signal to the diodes and the charge on C2 will diminish because of current flow to the input resistance of the latch amplifier. When C2 has discharged below a certain point, the latch solenoid will energize and turn off the player. The time constant between end-of-play and turn-off is usually about ten seconds. Therefore, if a defect develops in the sense mechanism, the player will eject the cassette ten seconds after it is inserted. Typical defects include oxidized sense brushes or points, and broken sense-assembly lead wires. The latter defect is very common.

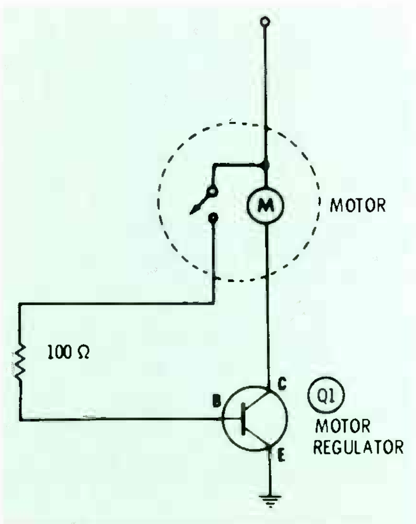


Fig. 7 A centrifugal regulator switch inside the motor forward-biases the regulator transistor whenever the motor shaft speed drops below the trigger threshold.

Typical Problem No. 8

Speed problems continue to be the number one defect. One of the most common problems is drag or slow speed. **Less frequently the speed is excessive.** One cause of fast-running is a stuck regulator switch inside the motor. This switch is a centrifugal type that opens and closes at a specific trigger speed. If the motor rotation is faster than this speed, the switch opens and deprives the motor of power. When the speed slows down, the switch recloses, causing the motor to be re-energized. The tape player speed is not actually constant but, rather, it varies back and forth across a narrow range. The speed variations in this case are too small to be noticed by the listener. Figure 7 shows the simplified schematic of a typical motor-speed control circuit. The centrifugal switch supplies power to the base of a regulator transistor which triggers-on the transistor and causes the motor to speed up when the speed drops below the threshold. Under these conditions, the motor will begin to speed up to the trigger speed. When it is reached, the switch opens and removes bias from the transistor. This causes the motor to slow down once again.

Plastic transistors in the regulator circuit tend to develop open elements. In such cases, the motor can't run. Another type of defect has been found in a lot of Delco T-400 series "Slimline" players. In these instances, the transistor is a NPN type packaged in a TO-3 case. It is mounted on the left side of the rear apron on the player chassis. In certain installations, a mounting screw protrudes through the bottom lip of the player and touches the transistor. Because the case of the transistor is connected to the collector, this simulates a shorted transistor. And the defect can be maddening because the player checks out okay on the bench, but in the car runs three times faster than normal. □

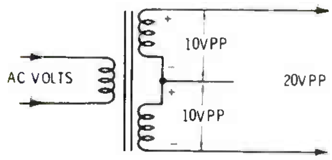
Scope waveforms solve the mysteries of CHROMA DEMODULATORS

Part 1 of a 2-part series by Carl Babcoke

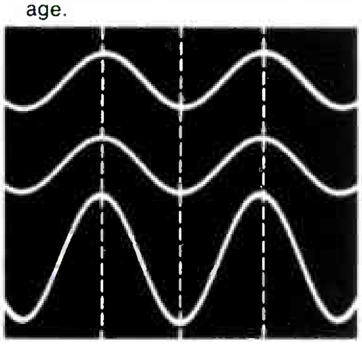
Most technicians take on faith the theory of color demodulators and the waveform drawings found in textbooks. But when actual scope waveforms and DC voltages are analyzed, we find that tube-type demodulators are only pulse generators whose output voltages depend on the phases of the chroma and carrier signals.

Part 1 covers the addition of signals having different phases, and a description of two basic types of demodulators. In September, part 2 will explain the popular pentode and diode demodulators.

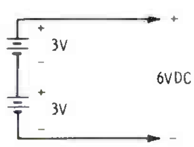
Fig. 1 Series connection of sine waves which have the same phase results in simple addition of the two voltages. This is comparable to the connection of batteries in series.



(A) Two transformer windings of the same phase produce a series-aiding addition of voltage.



(B) Multiple exposures made from a scope (without changing the vertical gain control setting) prove that sine waves of the same phase add completely. The dotted lines show each 180 degrees.



(C) Two 3-volt batteries wired in series-aiding produce an output voltage which is the sum of each voltage.

The Effects Of Phase On The Addition Of Sine Waves

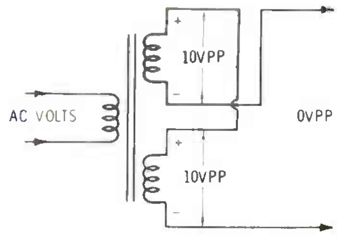
Two sources of sine waves having the same phase can be connected in series, as shown in Fig. 1A. The resulting output voltage is a simple addition of the two voltages, as shown in the scope waveforms of Fig. 1B. For example, if one voltage were 10 volts p-p and the other were 6 volts p-p, the output voltage would be 16 volts p-p.

Batteries wired in series-aiding, (Fig. 1C), produce an output voltage which is the sum of the two voltages. This is the DC equivalent of adding in-phase sine waves.

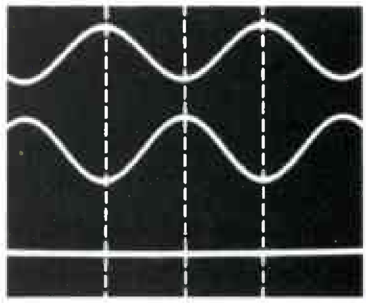
Addition of out-of-phase voltages

The addition of out-of-phase voltages is actually subtraction. Two sine waves of the same voltage but 180 degrees different in phase, when added in the circuit of Fig. 2A, produce zero output voltage. This is verified by the waveforms in Fig. 2B.

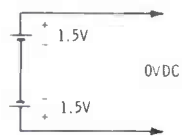
Fig. 2 Subtraction results from the series connection of sine waves having 180 degrees relative phase. Batteries wired in series-opposition also produce a subtracted voltage.



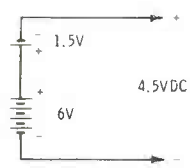
(A) Two windings of the same transformer can be wired out-of-phase to give a series-opposition subtraction of voltage.



(B) Multiple exposures made from a scope (without changing the setting of the vertical gain control) prove that sine waves of 180-degrees relative phase and equal voltages cancel.



(C) Two 1.5-volt batteries wired in series-opposition produce zero output voltage.

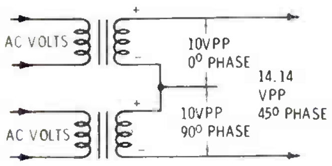


(D) A 1.5-volt and a 6-volt battery connected in series-opposition produce 4.5 volts which has the polarity of the higher-voltage battery.

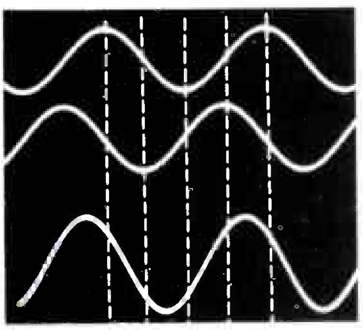
When the voltages of the out-of-phase sine waves are not equal, the output voltage is the difference between the two voltages, and the phase of the output signal is that of the larger voltage. If one winding of the transformer in Fig. 2A produced 10 volts p-p, and the other produced 6 volts p-p, the output would be 4 volts p-p and the phase of the signal from the 10 volt winding.

The circuit of two batteries connected in series-opposition in Fig. 2C, is the DC equivalent of the addition of two equal out-of-phase sine waves. A DC example of the addition of unequal out-of-phase sine waves (see Fig. 2D) is the series-opposition connection of a +6 volt battery with a −1.5 volt battery to produce an output of +4.5 volts.

Fig. 3 Two sine waves of phases other than 0 degrees or 180 degrees add partially or subtract partially.



(A) Schematic of a circuit using two transformers to supply sine waves which have 90 degrees relative phase.



(B) Addition of two sine waves of 90 degrees phase and equal voltages produces an output sine wave which is about 1.4 times the amplitude of each input voltage and has a phase of 45 degrees. The dotted lines show each 90 degrees.

The terms "opposite phase" or "out-of-phase" normally means that the phase difference is 180 degrees. The term "in-phase" means that the phases of both signals are the same. Occasionally, this condition is called 0 degrees.

Addition of sine waves having other phases

Sine waves of relationships other than the 0-degree and 180-degree phases already mentioned, also add when combined. However, the output voltage or the phase is not found by simple addition of subtraction.

Two sine waves of 90-degree relationship are added in the circuit of Fig. 3A, and the waveforms and amplitudes of the two signals plus the resultant sine wave are included in Fig. 3B.

If you carefully measure the three scope waveforms, you will find that the sum of two 10-volt p-p 90-degree sine waves is about 14 volts p-p. Mathematicians tell us that the exact figure is 1.414 times either of the two equal input voltages. There is no DC equivalent for this unique partial addition.

Vector Diagrams

The solution of phase problems by the use of vector diagrams is very useful in some applications. Because it is not essential to our method of analyzing demodulators, we will not explain vector diagrams.

Electronic Addition And Subtraction

If the color TV system were different so that the suppressed carrier at the transmitting station was amplitude modulated by only one chroma signal, and the receiver needed only one chroma signal following demodulation, the chroma signal and the 3.58-MHz reference carrier in the receiver could have been combined as in the circuit of Fig. 3A. This would restore the missing sub-carrier, and demodulation could have been accomplished by a single-diode, envelope detector (similar to a video detector).

In the actual color TV system, however, the chroma signal is a composite of **two** chroma signals, so this composite changes both in amplitude and in phase. Two or three demodulators are

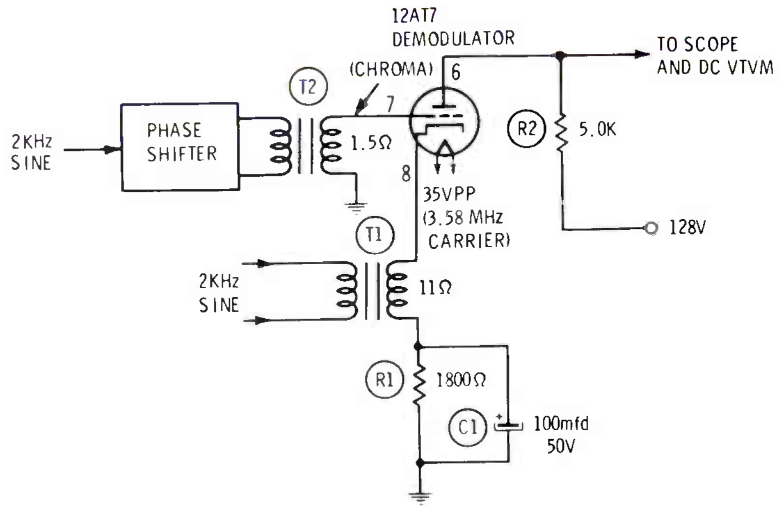


Fig. 4 This is the schematic of a typical overbiased-triode demodulator circuit. To obtain waveforms which could be photographed from the screen of a service-type scope, audio sine waves of 2000 Hz were used to simulate the chroma and 3.58-MHz carriers. Capacitance values were increased to keep the circuit actions authentic.

required; therefore, the reference carrier and the chroma signal **never** can be connected directly together.

Instead of a direct connection, the reference carrier is applied to one element of a tube, transistor, or diode, and the chroma signal is applied to another element of the same tube, transistor, or diode. Addition or subtraction, which occurs because of the phase difference between the two signals, is accomplished in the electron stream.

In some cases, the phasing appears to be reversed. For example, a 0-degree sine wave applied to the grid affects the tube in the same way as does a 180-degree sine wave of the same amplitude applied to the cathode. To the tube, the signals appear to be in-phase. In another case, signals of the same phase are applied to the anode and cathode of the same diode. These sine-wave signals act in the circuit as though they were of opposite phase. From the viewpoint of the diode, the signals subtract.

Important Characteristics Of Chroma Demodulators

Regardless of the basic type of circuit used, each chroma demodulator must have the same general specifications which are:

1) A chroma IF signal and a 3.58-MHz carrier must be supplied to separate points of each demodulator.

2) The output signal must be a DC voltage that changes linearly as the phase relationship between the two signals is varied linearly.

3) The DC output-signal voltage must change linearly as the amplitude of the chroma signal changes linearly.

4) The DC output-signal voltage must be capable of deviating to either above or below the voltage produced by no chroma signal.

5) A chroma signal of 90-degrees phase relative to the 3.58-MHz carrier must produce the same output-signal voltage as obtained without any chroma signal. So, when two demodulators are separated by 90 degrees, each ignores the phase of signal intended for the other.

Design engineers, no doubt, are concerned with additional factors such as cost, efficiency, frequency response and how the demodulator fits in with the remainder of the chroma circuit. But after the design work is finished and the receivers manufac-

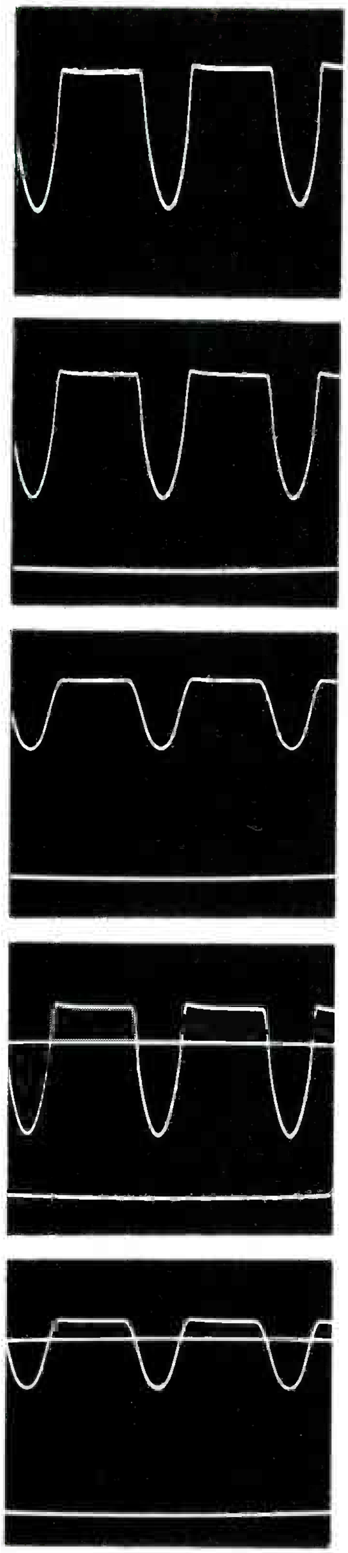


Fig. 5 Multiple-exposure photographs taken of the scope screen add information about the relationship between B+, zero voltage, and the average plate voltage, in addition to the usual waveform.

(A) 90-volt p-p pulses were obtained at the plate when the grid signal was a sine wave of 35 volts p-p. These pulses are the clipped lower 40 percent of a sine wave. However, the waveform provides no hint of the supply voltage or of the average voltage.

(B) Addition of the zero-voltage line shows the amount of pulse compared to the DC supply voltage. The horizontal lines at the top are the B+ supply voltage, because at that time the tube current was cutoff. Measured on the DC scope, the supply voltage was +135 volts and the pulse was 90 volts p-p.

(C) This waveform resulted when the grid signal was reduced to 12.5 volts p-p. The average DC voltage at the plate changed compared to Fig. 5B, but the amount of change cannot be seen.

(D) By the alternate use of the AC and DC functions of the scope, an accurate +112 volt average-voltage line was added to Fig. 5B.

(E) By the same method, an accurate +124 volt average-voltage line was added to Fig. 5C, and this permits a meaningful comparison with Fig. 5D.

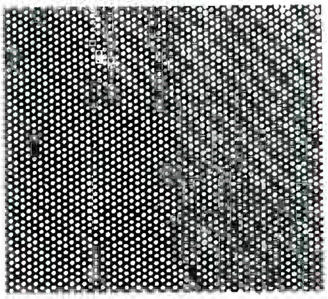


Fig. 6 If the pulses are not filtered-out following demodulation, an effect much like coarse screen wire which has been turned at an angle will be seen on the screen of the picture tube.

tured, these five characteristics of demodulators are the ones which should concern technicians.

As the actions of the various basic types of demodulators are discussed, we will check against this list to see if the specifications are being fulfilled.

Demodulation By An Overbiased Triode Tube

The schematic of a typical overbiased-triode demodulator circuit is shown in Fig. 4. Similar circuits were used in many of the early color receivers.

When the cathode-bias resistor has a larger value than is normal for use in audio amplifiers, and there is no input signal, the tube draws very little plate current, and the plate voltage nearly equals the supply voltage. If a small-amplitude audio signal were applied to the grid, some amplification would occur. However, the gain would be low and the distortion excessive. For audio usage, this represents poor design; but the circuit is a good demodulator.

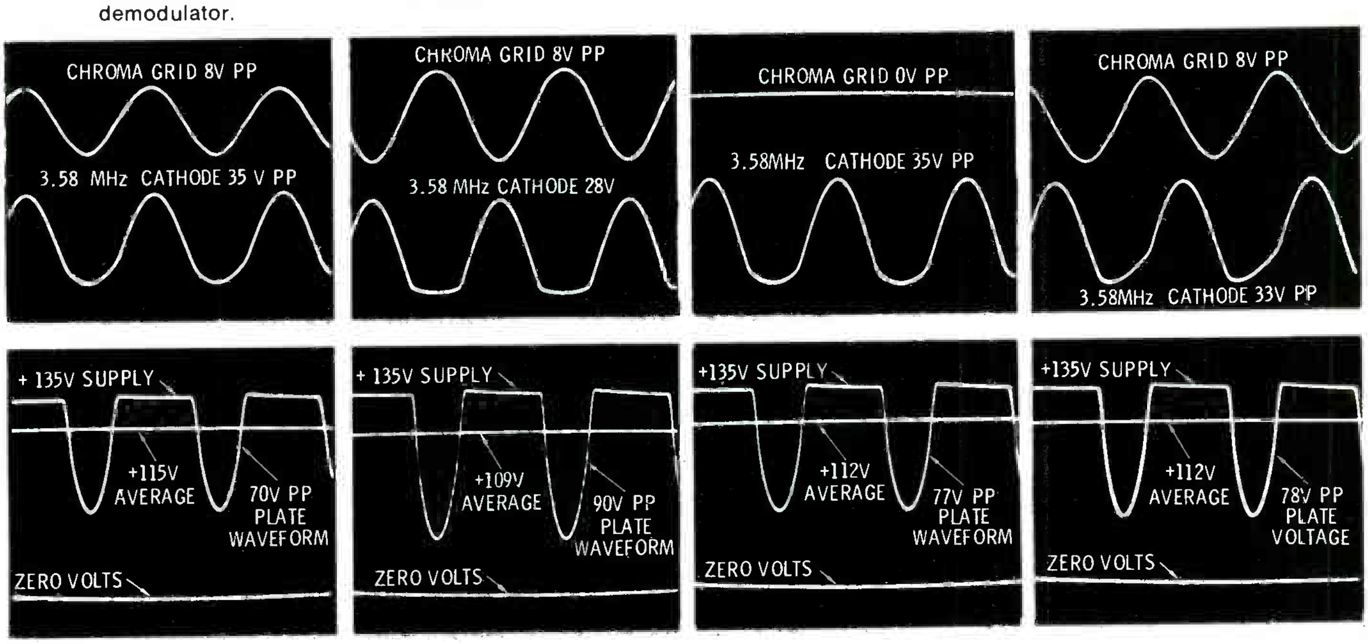
Non-linear operation causes the plate voltage to change with signal amplitude

Assume that a large sine wave is applied to the grid of the tube in Fig. 4. The negative peak causes little change in plate current, because there was little current before the negative peak arrived. Virtually no action takes place.

Not so when the positive peak arrives. The cut-off bias is reduced, plate current rises to near-saturation, and the plate voltage greatly decreases. Only the positive peak produces plate current and amplification. Therefore, the output contains negative-going pulses, as shown in Fig. 5A.

Another effect, which builds up in intensity over several cycles of the sine wave, also increases the cut-off bias. Increased plate-cathode current, which occurs during the positive-going peak of the grid signal raises the voltage drop across R1, the cathode-bias resistor. The storage effect of C1, the cathode-bypass capacitor, also maintains this increased bias voltage during the negative

Fig. 7 These waveforms and voltages were produced by the action of various phases in the overbiased-triode demodulator.



(A) In-phase chroma and 3.58-MHz signals appear as though they were out-of-phase to the tube. Therefore, the effect was that of a reduction in signal amplitude. The average plate voltage increased above that obtained without chroma.

(B) Out-of-phase input signals appeared to the tube as though they were in-phase. Therefore, the effect was that of an increase in signal amplitude, which caused increased plate current. The average plate voltage decreased below that obtained without chroma.

(C) Without a chroma signal, the average plate voltage was determined by the amplitude of the 3.58-MHz carrier and the amplitude of the pulse at the plate.

(D) Signals with a relative phase of 90 degrees produced the same average plate voltage as that without chroma. The addition of the signals for ¼ cycle and the subtraction for another ¼ cycle is shown by the tilted cathode waveform.

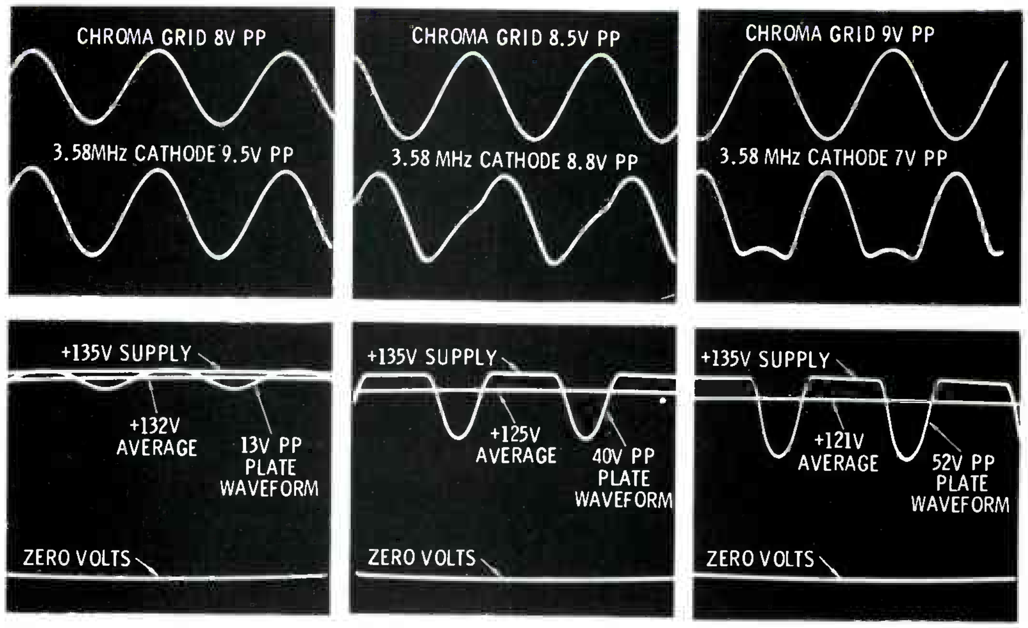


Fig. 8 A weak 3.58-MHz carrier produced a non-linear output signal. The color bars on the screen of the picture tube appear dark, because the average plate voltage was **not** the same for 90-degree phase as it was for no chroma.

(A) Normal-amplitude chroma in-phase with weak 3.58-MHz signal nearly cancelled to produce a very low composite input signal to the tube. The average plate voltage was 7 volts higher than the voltage with 90-degree phase, and the output waveform was a near-sine wave.

(B) Normal-amplitude 90-degree chroma and weak 3.58-MHz signals produced an average plate voltage that was 2 volts higher than the voltage without chroma.

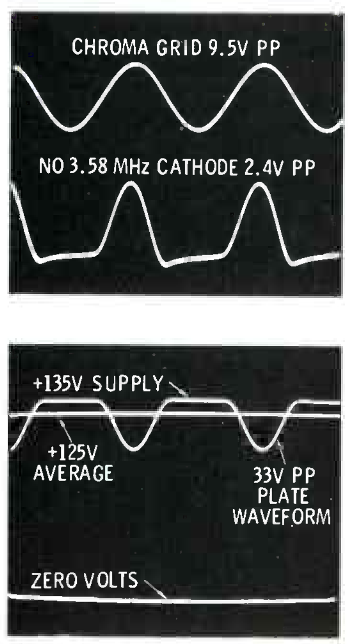
(C) Normal-amplitude out-of-phase chroma and weak 3.58-MHz signals produced an average plate voltage 4 volts lower than that with 90-degree phase, and 2 volts lower than the voltage without chroma.

half of the cycle. The final bias is higher than that without a signal, and this permits the flow of plate current for only about 40 percent of the sine wave.

When you troubleshoot this demodulator circuit, the DC voltage measured from cathode to ground can be used to indicate the relative amplitude of the 3.58-MHz carrier. Turn down the color control, measure the cathode voltage and compare the reading against that in PHOTOFACT, or other service data. A lower cathode voltage indicates a weak tube, or a decreased amplitude of the 3.58-MHz carrier.

In Fig. 5, you'll note that a decrease from 35 down to 12.5 volts p-p in the amplitude of the sine wave which was applied to the grid increased the average plate voltage from +112 to +124, a change of 12 volts. Other input voltages caused the plate voltage to change in the same proportion. This verified that the average DC voltage changed linearly according to the change in the amplitude of the applied signal. If the addition of a second signal would have the effect of adding or subtracting from the first, then the plate voltage would vary, and the result would be demodulation.

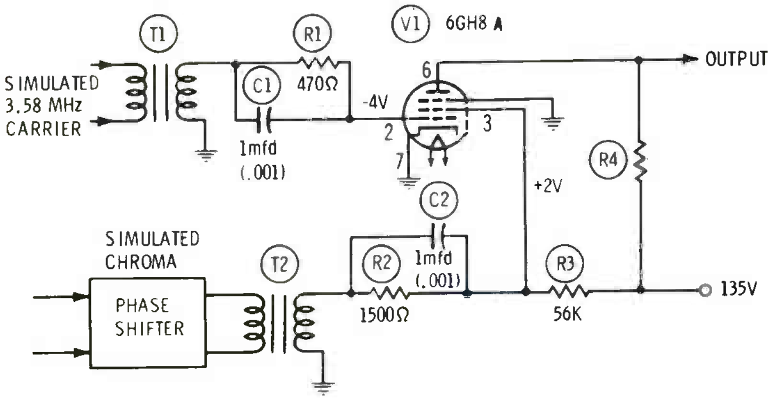
Fig. 9 Loss of the 3.58-MHz carrier to the overbiased-triode demodulator caused all color on the screen of the picture tube to be magenta in hue. The average plate voltage without either chroma or 3.58-MHz signals was +134 volts. With strong chroma and no 3.58-MHz carrier, the average plate voltage was +125 volts; this is 9 volts negative-going. Therefore, after reversal in the −Y amplifiers, both R-Y and B-Y signals at the picture tube make the red and blue hues brighter. Because green is derived from negative amounts of red and blue, the green brightness is reduced. Therefore, any portion of the picture which should be in **any** tint will be a weak magenta, and the tint control will have no effect.



The pulses must be eliminated

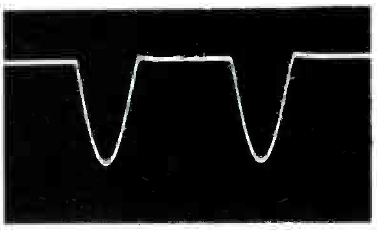
When this circuit is used in a color receiver, the pulses present at the plate must be filtered out before the signal reaches the picture tube. The filtering is by use of a bypass capacitor connected from plate to ground, and a peak-

Fig. 10 Demodulation also occurs when the 3.58-MHz carrier is applied to the control grid, and the chroma signal is applied to the screen grid of a pentode tube.



(A) Schematic of the "X" demodulator used in some RCA chassis, and in other brands. The negative grid voltage can be used as an indicator of the amplitude of 3.58-MHz reference carrier which is applied to the grid. Higher or lower DC screen voltages reduce the color saturation.

(B) This waveform shows that grid current flows for about 40 percent of each cycle. The RC network in the grid circuit has too short a time constant to make the rectifier action peak reading (which would narrow the waveform of grid current and also narrow the waveform at the plate).



ing coil in series with the output-coupling capacitor. If the pulses are not filtered out, the "screen wire" effect of Fig. 6 can be seen on the screen of the picture tube.

Input signals to the demodulator

In typical applications, a large 3.58-MHz reference carrier of unchanging amplitude is applied continuously to the cathode of the demodulator tube. A chroma signal, whose amplitude is determined by the adjustment of the color control, is applied to the grid.

Correct phasing of these two signals is necessary, else a color might be darkened, rather than brightened as intended. And the correct phasing **appears** to be reversed in this circuit, compared to others. A negative-going signal applied to the grid of a tube produces a positive-going signal at the plate. A positive-going signal applied to the cathode **also** produces a positive-going signal at the plate. If the phases of the grid and cathode signals are to have the same effect on the tube, the phases relative to ground must be opposite, or 180 degrees.

Demodulator action when the phase is changed

The waveforms of Fig. 7 illustrate demodulation actions which occur during these four basic conditions: both input signals in-phase; the signals out-of-phase; the signals at 90 degrees; and without a chroma signal. Waveshapes and amplitudes of the input and output signals are shown for comparison.

If Fig. 7A, the grid and cathode signals are in-phase relative to ground. Therefore, they are out-of-phase to the tube, and they subtract. Cathode signal of 35 volts minus the grid signal of 8 volts gives an actual signal to the tube of only 27 volts.

The out-of-phase inputs in Fig. 7B add to give a larger input to the tube. However, the cathode waveshape and amplitude have been changed because the cathode current develops a degenerative voltage across the inductance of the transformer winding which supplies the AC signal to the cathode. In other words, the cathode waveshape is a composite of the distorted cathode current caused by the grid voltage plus the cathode signal from the transformer.

The total input to the tube is 28 volts of cathode signal plus 8 volts of grid signal, or 36 volts p-p. This grid-cathode voltage produces a lower average plate voltage than that of Fig. 7A.

Operation without a grid (chroma) signal is shown in Fig. 7C. No grid signal is present to add or subtract from the cathode signal, so the average plate voltage is exactly midway between that of the two previous conditions. This fulfills specification numbers 3 and 4 for demodulators: a demodulator must produce a linear output voltage which can be either positive or negative relative to the voltage obtained without a chroma signal.

90-degree demodulation

Figure 7D shows the results obtained when the cathode signal lagged the grid signal by 90 degrees. The average plate voltage was the same as that obtained when there was no chroma (grid) signal. Thus the 5th specification for demodulation (a signal of 90 degrees relative to the carrier must produce an output signal of the same voltage as a zero signal) was fulfilled.

Visualize the circuit action this way: In Fig. 7A, 0-degree signals subtracted completely, and in Fig. 7B, 180-degree phases added completely. Ninety-degree phases added for ¼ cycle and subtracted for ¼ cycle (the other two ¼ cycles occured during the time the tube was cut off), therefore the final effect was a zero-change—just as though there were no grid (chroma) signal. Your proof is in the tilted cathode waveform.

Dark color bars

A puzzling symptom can be seen at times on the screen of receivers using this type of demodulator circuit. The symptom appears when the 3.58-MHz carrier at the demodulators is weak and a strong color bar pattern is used. As the color control is advanced to produce brighter colors, the color bars appear to turn dark, yet the color is actually brighter. The effect seems to be of color bars placed on top of dark bars.

The waveforms and voltages shown in Fig. 8 can be used to explain this odd symptom. When the grid (chroma) signal was changed from 90 degrees to 0 degrees, the average plate voltage increased 7 volts (a larger change than normal). When the grid signal was changed from 90 degrees to 180 degrees, the average plate voltage decreased only 4 volts, a nearly-normal change. Both changes should be equal in a non-defective curcuit.

In normal operation, the brightest red bar is supposed to be No. 3 from the left side of the screen. However, this brightest red bar is not 100-percent red. The 3rd blue bar is at crossover, which means the blue is as bright as it is in the background between the bars. The green bar is slightly darker than background, but still has some brightness. Therefore, a normal 3rd bar has bright red plus a noticeable amount of blue and green.

Analyze the conditions shown in Fig. 8, invert the change in average plate voltage because of amplification and polarity reversal in the -Y amplifiers and apply this information to the conditions for normal color bars. Very strong colors receive the correct brightness, but weaker colors or those below background level are reproduced darker than they should. The 3rd bar becomes pure red without the weak blue and green that should be seen as white. Therefore, the bar appears to become **blacker** as the color is increased.

All colors are magenta

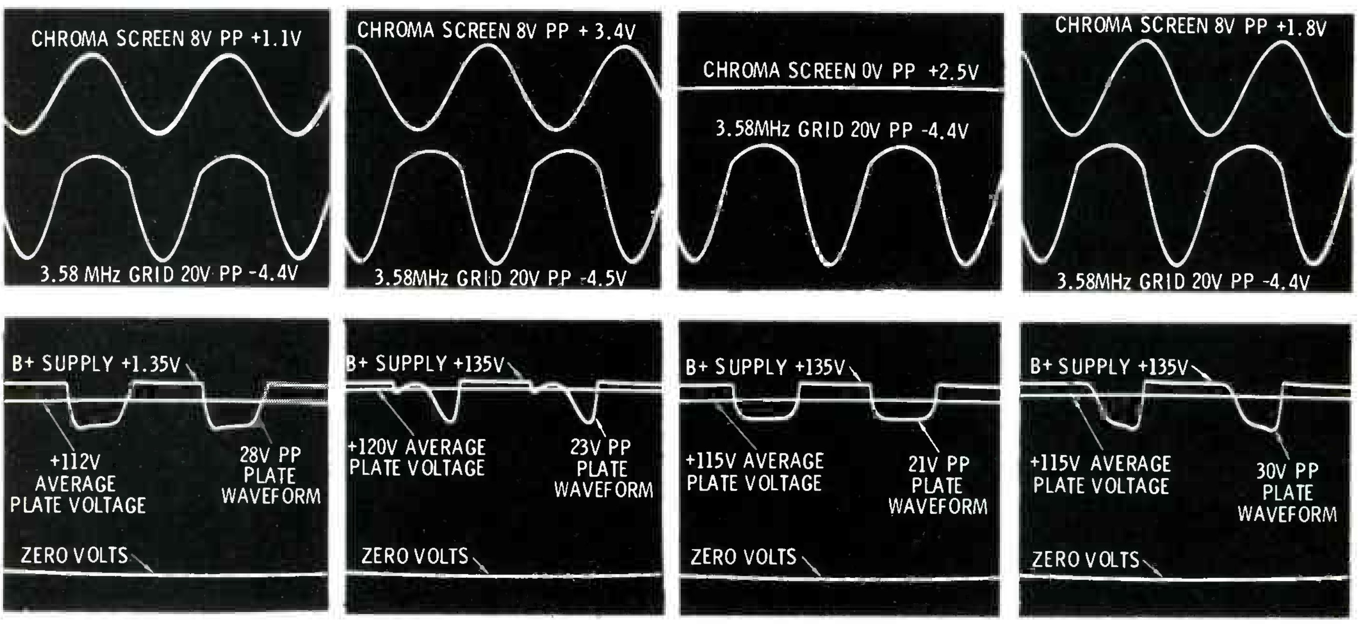
Another symptom, that is unique to the overbiased-triode tube demodulator, is produced by a total loss of 3.58-MHz carrier. All color bars become a weak magenta (purple). The tint control has no effect, but the color control operates normally.

The voltages and waveforms in Fig. 9 can be used to explain this symptom. Without a cathode (3.58-MHz) signal, and with the color control turned down completely to eliminate the chroma (grid) signal, the average plate voltage was +134 and there were no plate waveforms.

With the color control turned to maximum (9.5 volts p-p of grid voltage), the voltages and waveforms of Fig. 9 were produced. Both the cathode and plate waveforms show the clipping which occured because the signal exceeded the bias. However, notice that the average plate voltage measures +125 volts. This is a decrease of 9 volts from the plate voltage measured without a grid (chroma) signal. In other words, a chroma signal of any phase caused a reduced DC output voltage relative to that for no signal.

After the polarity is inverted by the -Y amplifiers, the red and blue grids of the picture tube become more positive when there is chroma (of any hue), and the green grid becomes less positive (because the green is de-

Fig. 11. These waveforms and voltages were produced by the action of various phases in the grid/screen-grid demodulator.



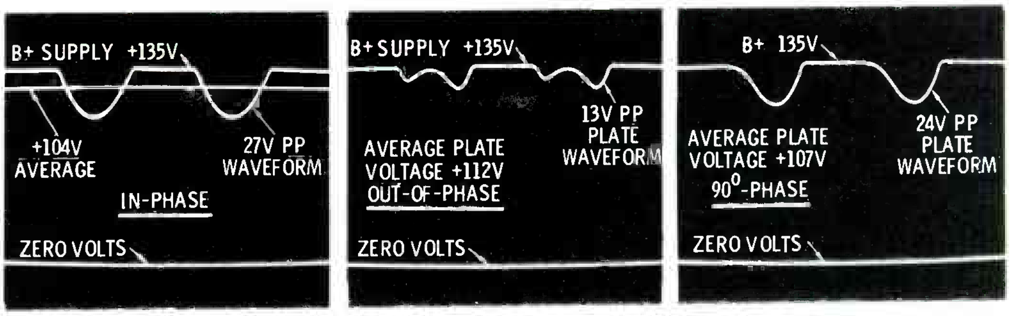
(A) In-phase chroma and 3.58-MHz signals added to produce an average plate voltage which was less positive than that without chroma.

(B) Out-of-phase signals subtracted to produce an average plate voltage which was more positive than that obtained without chroma.

(C) Without a chroma signal, the average plate voltage was determined by the amplitude and waveform of the plate pulse produced by the 3.58-MHz carrier at the control grid.

(D) Signals of 90-degrees relative phase added for a portion of the cycle and subtracted for another portion of the cycle. Therefore, the average plate voltage measured the same as that without chroma.

Fig. 12 The grid/screen-grid demodulator produced nearly the same amount of change in the average plate voltage (output signal) even when the 3.58-MHz signal applied to the grid was very weak. This result was a surprise, but it did correspond to observations made during actual servicing.



rived by addition and inversion of R-Y and B-Y signals). The result is magenta hues where ever **any** hue should be seen in either the colorcast picture or the color bars.

Screen-Grid Demodulation

Several models of RCA color receivers have used demodulators similar to the schematic in Fig. 10A. In this circuit, the chroma was injected at the screen grid (which was operated at a very low positive voltage), and the 3.58-MHz carrier was applied to the control grid.

A large 3.58-MHz reference carrier is present continuously at the control grid of the tube. The amplitude is sufficient to cause heavy grid current. Although C1, R1 and the diode action of the grid and cathode of the tube have the correct schematic to functon as a peak-reading series rectifier (much like the grid circuit of many oscillators), the time constant is too short to permit the storage of much voltage in C1. Consequently, grid current flows for approximately 40 percent of the time, as shown by the waveform of the grid current in Fig. 10B. This is nearly the same as the conduction time of the previously-discussed overbiased-triode demodulator.

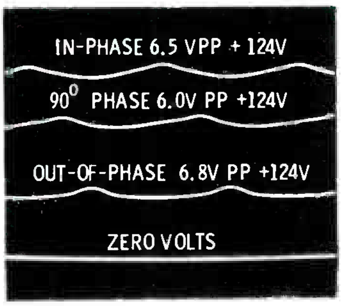


Fig. 13 Without a 3.58-MHz carrier, the grid/screen-grid demodulator produced virtually no output waveform and no change in the average plate voltage, either with or without chroma. These results indicate that no color will be seen on the screen of the picture tube when the 3.58-MHz oscillator is dead.

Normal operation

All the voltages and waveforms produced by simulated demodulation in the circuit of Fig. 10A are shown in Fig. 11. The action of in-phase, out-of-phase, 90 degree and no-chroma signals produce average DC plate voltages which change according to the relative phase of the two carriers. However, in this circuit the grid-cathode signal is unchanged in amplitude by the two signals. Instead the screen voltage (DC plus the chroma signal) modulates the plate-cathode current. The effect on the average plate voltage (output signal) is the same as in the previous circuit, although the pulses at the plate are flattened by saturation when the 3.58-MHz carrier is normally strong.

Weak 3.58-MHz carrier

Surprisingly, this demodulator circuit measured nearly the same change of average plate voltage (output signal) when the 3.58-MHz carrier was reduced to only 4 volts p-p. Figure 12 shows the plate waveforms obtained from in-phase, out-of-phase, and 90 degrees operation of the two input signals.

No color when the 3.58-MHz carrier is missing

Figure 13 shows the signal at the plate for the four conditions of chroma phase when the 3.58-MHz carrier was missing. Because the plate waveforms are symmetrical and the average DC voltage unchanged, we can safely conclude that a color receiver which used demodulators of this type will show no color if the 3.58-MHz carrier is missing at the demodulators.

Troubleshooting the screen-grid demodulator

Such a low positive voltage applied to the screen grid prompts the sneaky thought that a higher voltage might make the circuit operate better. Unfortunately for that theory, either a higher or lower screen voltage gives less demodulated output.

If the screen voltage is lower, perhaps because R3 has increased in value or C2 is leaky, the pulses at the plate decrease in amplitude and become rounded, and the change in average plate voltage decreases (less chroma).

If the screen voltage is higher, perhaps because R2 has increased in value or R3 has burned and decreased in value, the pulses at the plate acquire sharp corners and their amplitude cannot be changed by the (chroma) signal at the screen grid. Consequently, the output of the demodulator is decreased and less color can be seen on the screen.

Coming

Next month in Shop Talk, we will explain and illustrate suppressor/control-grid pentode and diode demodulators. □

Standard Troubleshooting Techniques, part 2

A REVIEW OF STATIC TESTS AND VOLTAGE ANALYSIS

In part 1 of this series, writer-technician Anderson described substitution techniques, and how to avoid some of the potential errors. The advantages and limitations of testing tubes and transistors also were summarized. In part 2, static testing of components and the basics of voltage analysis are explained.

By Bruce Anderson
ES Contributing Author

Static Tests

The condition and value of **any** component in a TV receiver can be determined by static tests. That is, tests made when there is no power applied to the chassis. But in practice, wholesale testing of large numbers of components requires too much time. Also, some of the test equipment is much too expensive for the information it provides.

Because of these factors, it is standard practice to minimize the number of suspected parts before performing static tests. Tubes and transistors are exceptions, for they are most often the cause of the trouble, and testing and substitution is relatively easy.

Ohmmeter tests

An ohmmeter is used most often to measure resistors. But it can take the place of a capacitor analyzer in many instances. Leaky or shorted capacitors can be discovered easily by disconnecting one lead and measuring the resistance. The normal resistance of capacitors (except electrolytics) should check nearly infinite. And many new-type electrolytics might have leakage resistance measuring in the megohms.

There really isn't (to the best of my knowledge) any rule-of-thumb for deciding the allowable leakage of a capacitor. In a filter capacitor, a leakage current of several milliamperes often can be tolerated; in a coupling capacitor, a few microamperes might seriously upset the bias of an amplifier.

Values of capacitance larger than about .001 Mfd can be found approximately by the use of an ohmmeter. It is well known that an ohmmeter pointer flips towards a low-resistance reading when the probes first are connected to a non-charged capacitor. Some technicians fail to take advantage of this effective test. Just notice how far the pointer deflects when first connected to the suspected capacitor, then compare the swing to that produced by a capacitor of known value. After a little practice, you can "guesstimate" values to about ±20%, even without resorting to comparisons.

Some defective capacitors break down or leak excessively under the operating voltage of the chassis, but show little leakage at the low test voltage of an ohmmeter. A quick check which works most of the time, is for you to disconnect the low-voltage end of a capacitor, apply power to the receiver, and measure the voltage from the disconnected end of the capacitor to chassis. This is a sensitive test, and few capacitors will fail to leak some voltage. In most circuits, a capacitor-leakage voltage of 10% (or less) of the voltage applied to the other end represents satisfactory performance. Of course, this is not a static test, but it is one that can be performed with a voltohmmeter.

Additional information about testing capacitors was included in the July, 1970 issue of ELECTRONIC SERVICING, starting on page 28.

Tests of Coils and Transformers

You can find an open winding, or a winding leaking to the frame or core of a transformer, by using an ohmmeter, but other defects require additional tests.

A short across one turn of the winding of a coil changes the inductance far more than it changes the DC resistance. One shorted turn in a coil having a thousand turns reduces the resistance only 0.1%; a virtually unmeasurable amount. However, the inductance of the entire winding is decreased excessively.

"Burn-ups" of power and flyback transformers are likely when any of their windings have shorted turns. This is because the power available to the pri-

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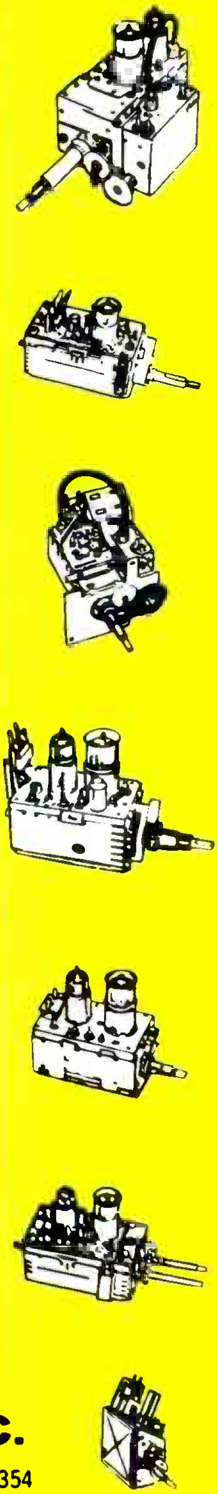

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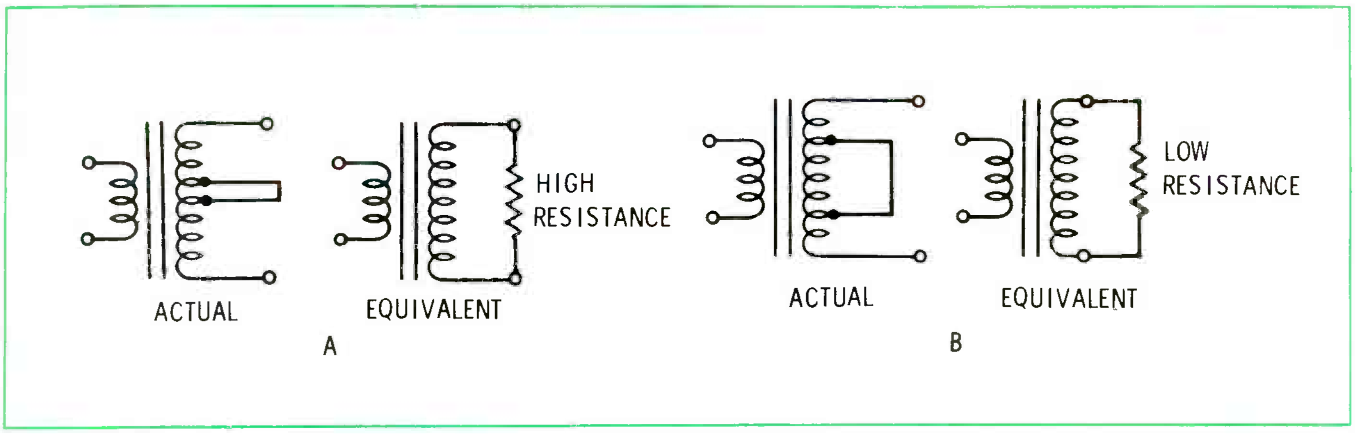


Fig. 1 Shorted turns and the electrical equivalents. **(A)** A one-turn short acts the same as a high resistance across the entire winding. **(B)** Shorts between layers of the coil are more serious. They act as a low-value resistor connected in parallel with the coil.

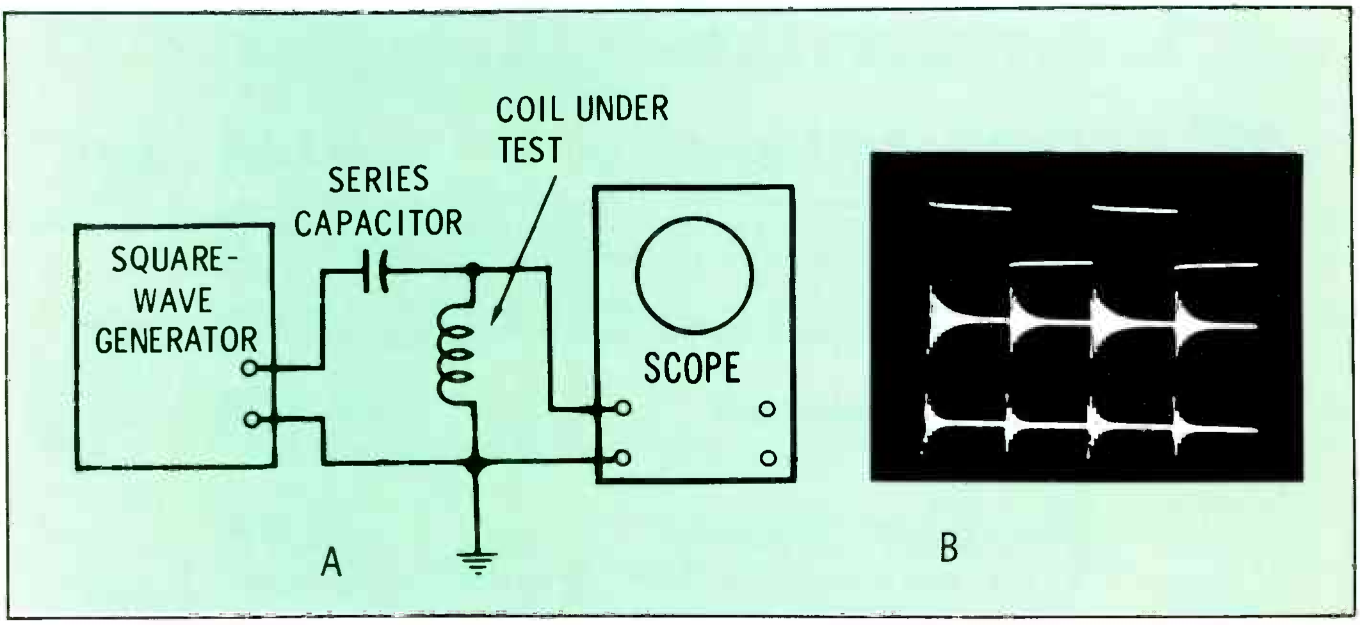


Fig. 2 Method of ringing an inductance with square waves. **(A)** Wiring of the equipment. **(B)** Top waveform is the output of the square wave generator. Center waveform shows normal ringing of a non-defective coil. Bottom waveform is the ringing of an inductance having a shorted turn. Notice that ringing occurs during both the rising and trailing edges.

mary is high, and therefore the current in the shorted winding is limited only by the resistance of the short.

A shorted turn in a low-power device, such as a tuned coil, acts as though a medium-valve resistor had been paralleled across the entire winding, as shown in Fig. 1A. The "Q" will be reduced. If the coil is part of a tuned circuit, the bandpass will widen and the amplitude decrease.

Shorts between turns in different layers of the windings represent a much heavier load on the windings. This is illustrated in Fig. 1B. Such shorts would cause a flyback transformer to burn-up, or prevent an IF transformer from tuning.

Inductance bridges can be used to find wrong inductances or shorted turns. However, the high initial cost of the instrument relative to the infrequent usage limits the value of bridges.

Ringing tests

A ringing test for coils and transformers can be a rapid and fairly accurate substitute for a check with an inductance bridge. Details about ringing tests were given in the October, 1970 issue of ELECTRONIC SERVICING starting on page 32. Two basic methods were explained there. One is to extract a pulse or a sawtooth from a scope and connect it through a capacitor to the coil under test. One advantage is that the display is always locked perfectly. The disadvantage is that the exact frequency is seldom known with the desired accuracy.

The output of a square-wave generator also can be used to "ring" inductances. The precise frequency is easy to obtain. Just remember that ringing is triggered by both the leading and trailing edges of the square wave. Therefore, use one-half the frequency which works best with sawteeth or pulses. The hookup

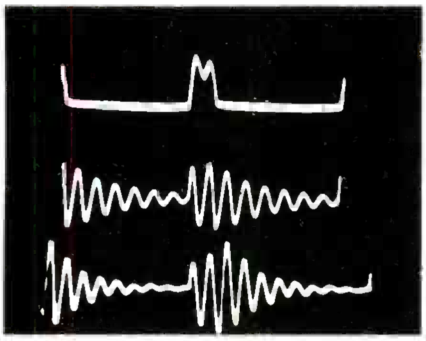


Fig. 3 A horizontal-sweep pulse from a TV receiver can be used to ring inductances. The top waveform is the pulse from a TV receiver, center waveform is normal ringing, and the bottom waveform shows ringing of an inductance which has shorted turns. Obviously, better ringing is produced by a generator pulse or a square wave than by this sweep waveform.

for ringing with square waves is shown in Fig. 2A.

Actual waveforms of ringing by means of square waves (see Fig. 2B) usually show part of the leading and trailing edges of the square waves. This appears as a small extra positive- or negative-going pulse at the beginning of each damped wavetrain. Ringing from pulses produces wavetrains which are all identical.

In an emergency, horizontal pulses from another TV chassis can be used as a source of the ringing signal. Use the circuit of Fig. 2A, except the generator and series capacitor are replaced by a test lead which is clipped around the insulation of the "hot" yoke wire. The two chassis must be connected together. Figure 3 shows waveforms typical of such a test.

Regardless of the source of the waveform which rings the inductance, shorted turns decrease the amplitude of the ringing and the amount of time the circuit rings. Extreme accuracy is not possible unless the frequency is precise and another known-good inductance is used as a standard. However, a seriously-shorted transformer does not require any hair-splitting decisions; it will not ring at all.

Neither the inductance bridge nor the ringing test is infallible when the shorted turns are caused by arcing inside the transformer. But, horizontal-output (flyback) transformers usually will heat excessively near the point of the arc, and thus indicate the defect.

We must always remember that static tests provide **evidence, not proof** of the condition of the components. A good technician interprets this evidence and repairs instruments. An amateur might accept the static test as proof and be misled into more serious troubles.

Dynamic Testing

Dynamic tests, for purposes of this article, are those which are made with power applied to the TV chassis, but do not include signal injection or signal tracing. So, most dynamics tests are performed with a voltmeter or VTVM. Of course, a DC scope could be used to measure both DC and AC voltages. And the AC function of a VTVM can replace a scope for some tests. It is sometimes necessary to measure current, but a simpler method is to measure the voltage drop across a resistor of known value. Then the current is calculated by the use of Ohm's Law.

VOM versus VTVM

Debates continue about the advantages of voltohmmeters versus VTVM's and FET meters. Here are some of the facts:

- On low voltage ranges, a VOM loads the circuit under test much more than does a VTVM.
- A VOM is usually more rugged, and does not require an electric zero adjust control.
- VTVM's are isolated from the AC line when manufactured, but an internal defect might connect the AC line to the test leads. This could cause the destruction of many solid-state devices before the meter defect is found. Electronic VOM's which are powered solely by batteries do not have this potential hazard.
- VTVM's can measure peak-to-peak voltages with only moderate loading of the circuit under test.
- VOM's have fewer components than do VTVM's and usually cost less. However, an overload might bend the needle of some VOM's, and this is virtually impossible with a VTVM.

Both types of instruments are standard in most shops. You must decide whether to use a VOM, a VTVM, or both.

DC scope versus DC voltmeter

Most test equipment manufacturers now are offering DC-coupled scopes, many of them triggered-sweep, at a price the average shop can afford. There are both advantages and limitations in using a DC scope to measure DC voltages. The following are some comparisons:

- A technician who already is using a scope for waveform analysis or p-p measurements finds it convenient to use the same instrument for DC readings.
- However, the usable scale of a 5-inch scope is about 4 inches compared to 6 or 8 inches of scale length on a meter face. Most technicians can read a meter faster and more accurately than a scope.
- A DC scope accurately can display a waveform riding on top of a DC voltage.
- However, a small waveform on a **large** DC voltage might be located off the screen of a DC scope.
- Without the 10X low-capacitance probe, the DC input resistance of a scope is 1 megohm. By comparison, a VTVM would be 10 megohms, or higher. With the 10X probe, a scope has about the same loading effect as a VTVM, but the sensitivity also has been reduced by a factor of 10.

The Significance of DC Voltage Measurements

Some defects in a circuit produce a radical change of DC voltages. Other defects change the DC voltages none at all. In some instances, an abnormal DC voltage measurement points clearly to the fault. But often it indicates only that we are testing in the general vicinity of the trouble. A few examples will illustrate these points.

Voltages in class "A" stages

Figure 4 shows the circuit of a typical pentode class "A" amplifier. Assuming that the tube is good, a defect in most of the eight components surrounding the tube will produce a different set of abnormal voltages. These are the symptoms and voltage readings:

- **C1 leaky or shorted:** Control-grid voltage is positive; plate and screen voltages are very low; cathode voltage is high (perhaps double); and the output audio signal is very distorted.

- **C1 open:** No change of DC voltages; no audio output.

- **R1 open:** After a short period of normal operation, the grid will become negative enough to cut off the plate current, causing distortion and loss of volume. Plate and screen voltages are very high; cathode voltage is very low. Merely touching a meter probe to the grid should restore normal operation for a time.

- **R3 open:** Cathode voltage is high (the cut-off voltage of the tube; probably about +4 volts); plate and screen voltages very high (nearly the same as the supply voltage); and control grid voltage normal; there will be no audio output signal.

- **C2 shorted or very leaky:** Cathode voltage is zero or low; plate and screen voltages low; control grid normal or slightly negative (if the grid rectifies the audio input signal); and the output signal will be distorted.

- **C3 leaky or shorted:** Screen voltage is low or zero; plate voltage high; cathode voltage low, control-grid voltage normal; little or no output signal.

- **C3 open:** All DC voltages are normal; decreased amplitude of output signal.

- **R4 open:** Screen voltage low or zero; plate voltage high; grid voltage normal; cathode voltage low; little or no output signal.

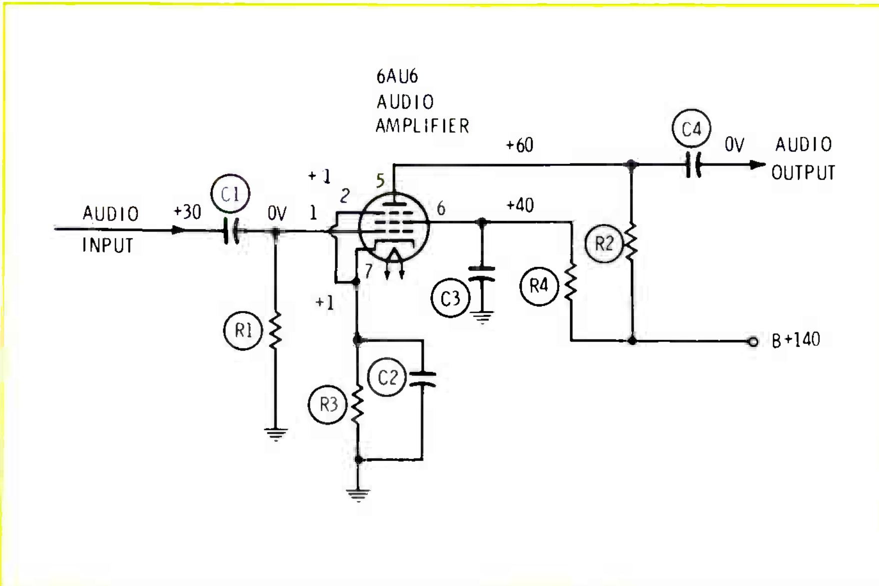
- **R4 reduced in value:** Screen voltage is higher; plate voltage lower, cathode voltage higher, control-grid voltage normal; usually the stage has more gain and increased amplitude of the output signal.

- **R2 open:** Plate voltage is zero; screen voltage low, cathode voltage slightly low; control-grid voltage normal; no output signal.

- **C4 leaky or shorted:** Plate voltage probably is slightly low; other voltages normal; output signal might be distorted.

- **C4 open:** All voltages are normal; no output signal.

Fig. 4 Schematic of a class "A" amplifier stage used as an example for DC voltage analysis.



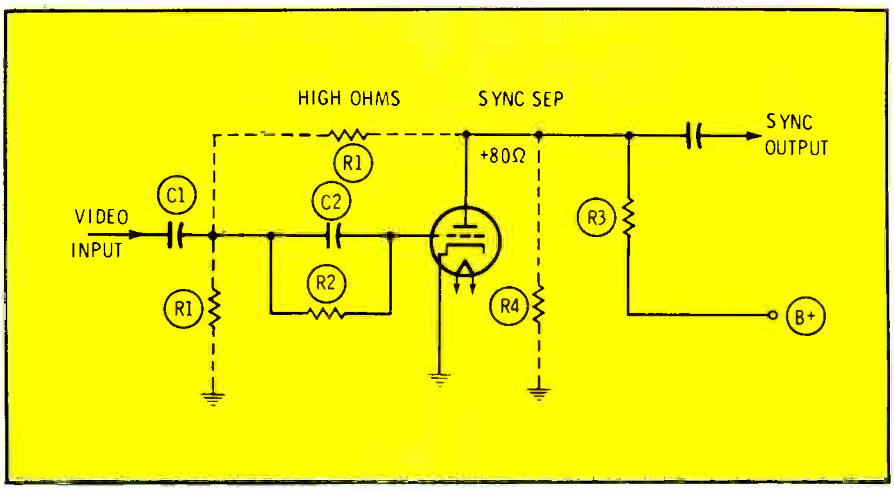


Fig. 5 Schematic of a typical sync separator stage is an example of a circuit whose DC voltages change according to the signal amplitude.

Some rules-of-thumb can be learned by an analysis of these conditions. For example, a defect causing a wrong voltage in the plate, screen or cathode circuit will affect the DC voltages in the other two circuits. A defect in the control-grid circuit changes the voltages in all three of the other circuits. Most defects and wrong voltages in plate, screen and cathode circuits do not affect the control-grid voltage. The exceptions to this last statement occur when the grid-cathode elements draw current, as in grid-rectification of the input signal.

Stages whose bias changes with signal

In the previous example, the bias was obtained totally from the cathode resistor and was self-regulating. Other stages in a TV receiver obtain bias from an external source, or the bias varies according to the amplitude of the input signal.

A typical sync separator, such as the one shown in Fig. 5, obtains its bias by grid-rectification of the input signal. This is done so the clipping action will be automatic regardless of whether the input signal is large or small. Positive-going video is supplied to the grid through C1, which acts as the peak-reading capacitor. Grid rectification occurs on the tips of the sync pulses and produces negative voltage. This negative voltage maintains the grid at a cut-off voltage until the next sync pulse arrives. Therefore, plate current is cutoff and the plate voltage is the same as the supply voltage, except when the grid draws current. When R4 is used, the supply voltage is a function of R3 and R4 which are operated as a voltage divider.

Defects can cause these symptoms and voltages:

- **C1 leaky or shorted:** Control-grid voltage is less negative, or even positive (depending on the amount of leakage); plate voltage is lower; output signal contains the needed sync pulses plus undesired video, because of poor clipping.
- **C1 open (or no input signal):** Control voltage is about -0.7 volt, if R1 returns to ground, or about +0.2 if R1 returns to a positive voltage; plate voltage is slightly lower than normal; no output signal.
- **R1 open:** Locking might be slightly critical; voltages could be unaffected if C1 has normal leakage for a paper- or Mylar-dielectric capacitor.
- **R3 increased in value:** Plate voltage low; grid voltage normal; decreased output sync pulses.
- **R3 decreased in value:** Plate voltage is high; grid voltage normal; increased amplitude of output sync pulses.
- **C3 open:** All voltages are normal; no sync pulses at the output.
- **C3 leaking or shorted:** Plate voltage is low; grid voltage normal; reduced amplitude of the output sync pulses might cause critical vertical or horizontal locking.

Practically all oscillators develop a steady grid or base bias of cut-off polarity when they are operating. This voltage can be used to prove whether or not the stage is oscillating, but it does not help to find the defect.

Summary

Dynamic testing with a voltmeter is most useful in circuits where the DC voltages normally are not changed by the presence of an input signal. Wrong voltages in such stages undoubtedly originate within that stage.

In other stages, such as AGC, sync separator, oscillator, blanker or horizontal output circuits, the voltages partially depend on the signals present. DC voltage measurements are of limited value in these circuits. An oscilloscope is a better instrument for use in such cases. □

bookreview

Semiconductor Diode Lasers
Author: Ralph W. Campbell and Forrest M. Mims, III
Publisher: Howard W. Sams & Co., Inc., Indianapolis, Indiana
Size: 8½ inches x 5⅜ inches, 192 pages
Price: Softcover, $5.95.

The theory of injection lasers has been simplified in this book to provide experimenters and design engineers with a broad introduction to these unique semiconductor devices. Numerous circuits for operating and detecting lasers have been included. Also shown are many conventional and infrared photographs of laser patterns. Chapter 1 of the book discusses the history and development of the laser with some attention to light-generating devices in general, and light generation by semiconductors. For example, the LED might be considered the direct ancestor of the semiconductor laser.

Contents: Light, Semiconductors, and Lasers—Injection Lasers and Their Properties—Fabrication and Commercial Devices—Pulse Generators, Modulators, and Power Supplies—Detectors and Receivers—Optics and Viewing Devices—Applications.

199 Color TV Troubles & Solutions (TAB Book No. 595)
Author: Robert L. Goodman
Publisher: TAB Books, Blue Ridge Summit, Pa.
Size: 5½ x 8½, 224 pages
Price: Softcover, $4.95; hardcover, $7.95.

This case history book of "tough dog" and recurring color TV troubles describes 199 problems. Symptoms, cures and simplified schematics are included. The content is arranged alphabetically from Admiral to Zenith and each case history is listed by chassis number and trouble. Some troubleshooting guides are given to help solve future problems. ☐

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1014 Wyandotte St., Kansas City, Mo. 64105

antenna systems report

Features and/or specifications listed are obtained from manufacturers reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

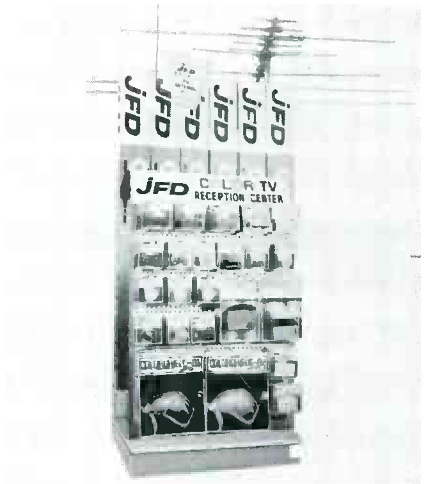
Communications Antenna Mount

Product: Model ASM-91 antenna mount
Manufacturer: The Antenna Specialists Co.
Function and/or Application: The mount swings horizontally to clear obstacles
Features: Model ASM-91 is made of high-impact Acrylonitrille Styrene and acrylic Terpolmer, a plastic that reportedly insures close tolerances and rigidity in the upright position. When the upper section is folded in one direction, the antenna is horizontal; folded in the opposite direction, it slides free of the deck mounting assembly for storage.
Specifications: The mount is furnished with three tapered spacer discs to permit vertical positioning of the antenna on surfaces sloping as much as 6 degrees.
Price: Model ASM-91 sells for $13.45.

Circle 50 on literature card

Antenna Installation Center

Product: Color television reception center
Manufacturer: JFD Electronics Corp.



Function and/or Application: Display rack for antenna kits and accessories for antenna installation.
Features: Display includes: set couplers, signal splitters, interference eliminators, matching transformers, signal pre-amplifiers, amplifiers, wall plates, lightning arresters, cable and other TV accessories. TV antenna kits engineered to suit almost all reception needs in local, suburban, near-fringe and fringe locations are also displayed.
Specifications: Each item is blister-packed for easy inspection by customer. The rack requires 36 inches x 16 inches of floor space.
Price: Not available ☐

Circle 51 on literature card

For more information about above products use reader service card

Circle 25 on literature card

test equipment report

Features and/or specifications listed are obtained from manufacturers' reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Solid-State Curve Tracer

Product: Model 501-A Semiconductor Curve Tracer by the B&K Division of Dynascan

Features: The curve tracer measures beta, leakage, breakdown voltage (nondestructive test), output admittance and the linearity effects of capacitance and temperature for signal and power bipolar transistors, J-FET's, MOS-FET's and UJT's. Also it tests the essential characteristics of diodes, zener diodes, tunnel diodes, triacs and SCR's. A socket switch permits the rapid comparison of transistors when

matching is needed. Transistors are supplied with calibrated base current, and FET's are supplied with calibrated gate voltage during tests. Electronic current limiting of the collector voltage supply eliminates voltage drops that could affect the curves, and provides tests up to 100 volts at 100 milliamps. Provision is made for calibration of the scope which is used as a readout. Supplied with the curve tracer are the cables to connect with a scope, a B&K FP-3 probe for contacting circuit boards, and a Mylar 10X10 graticule for your scope.

Price: The B&K Model 501-A Semiconductor Curve Tracer sells for $129.95.

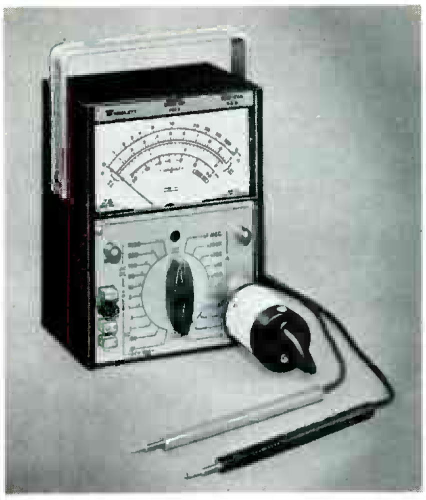
Circle 60 on literature card

Current Leakage Adapter

Product: Model 60-407 adapter by Triplett Corp.

Features: The AC current leakage adapter, with two test leads, is used in conjunction with Triplett's portable, battery-operated Model 601, 53 range, FET VOM. The units used together measures the leakage current present and determines if it is hazardous to the human body. AC currents of 10 μA, full scale, can be measured with the 601, which gives the user a safety factor of 50:1. This allows a deteriorating insulation condition to be detected by periodic inspections before insulation breakdown becomes hazardous.

Specifications: Current ranges are: 0-.01-.03-.1-.3-1 -3 -10 mA. Resolution is .2 μA on 0-.01 mA range. Accuracy is ±4 percent of full scale. Input impedance: 1500 ohms, shunted by 0.15 μF capacitance. A leakage current of 0.5 mA (500 μA AC) is the maximum



allowable. Sensitivity is 10 mV AC full scale at 10 megohm input impedance; 100 mV DC at 11 megohm input resistance.

Price: Model 601 sells for $166.00 with 48-inch leads, batteries, alligator clips, and instruction manual. Model 60-407 current leakage adapter sells for $25.00.

Circle 61 on literature card

Voltage Calibrator

Product: Quik-E by Pioneer /Instrumentation

Features: The calibrator is powered by three 9-volt batteries and can be connected to an external DC power supply of 23 to 28 volts. Activation is by a cover-mounted, three-way toggle switch.

Specifications: The Quik-E provides three output voltages: 10 VDC, 1VDC, and 100 mVDC; with ± 0.05 percent accuracy between 15-degrees centigrade and 35-degrees centigrade. The outputs are short-circuit proof.

Size & Weight: Dimensions are 3½ inches x 6 inches x 2 inches, and the weight is 8 ounces.

Price: The Quik-E sells for $89.50.

Circle 62 on literature card

Portable FET VOM

Product: Model IM-104 by Heath Co.

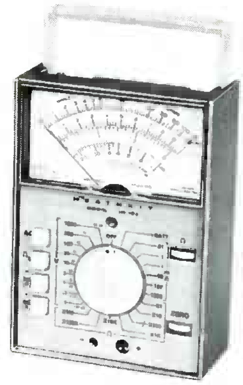
Features: Low-drift 1 percent metal-film and wire-wound resistors for stability, and dual FET meter amplifier circuitry for 10-megohm input impedance and instant operation. The 4½ inch taut-band meter is diode protected.

Specifications: Fifty-three ranges on four scales include nine DCV ACV ranges from 0.1 V to 1000 V; six current ranges from 0.01 mA to 1000 mA, DC and AC; seven resistance ranges

(Continued on page 64)

Circle 27 on literature card

(Continued from page 63)



from 1 ohm to 100 megohms, conventional or low voltage modes; decibel ranges from −40 dB to +62 dB; and DC null scale with 1 mV resolution.

Price: Model IM-104 sells for $79.95.

Circle 63 on literature card

Frequency Counter

Product: Model Digipet-60 Frequency Counter by Miida Electronics

Features: The range is from 1 KHz to 60 MHz with a resolution

of 1 Hz at 1 second or 1 KHz at 1 millisecond gate time. Can either be operated on AC or DC.

Size: The unit is 7 inches deep by 2½ inches high.

Price: The Digipet-60 Frequency Counter sells for $299.00.

Circle 64 on literature card

Portable Multitester

Product: Model F-60

Manufacturer: Speco

Function and/or Application: Measures DC and AC voltages, DC currents, resistances, and decibels.

Features: A zener diode provides meter protection, a Span-Band type of pivot is used for low friction of the pivot bearings, silver-plated switch contacts and a mirrored scale are provided.

Specifications: Ranges are: **8 DC voltage ranges,** from .3 volt full scale to 3000 volts full scale at 30K ohms per volt and an accuracy of ±3 per cent; **4 AC voltage ranges,** from 12 volts full scale to 1200 volts full scale at 10K ohms per volt and an accuracy of ±4 per cent; **4 resistance ranges,** from 3K ohms full scale to 30M ohms full scale and an accuracy of ±3 per cent; **5 DC current ranges,** from 60 microamperes

full scale to 12 amperes full scale at ±3 per cent accuracy; and **4 decibel ranges,** from −20 dB to +23 dB. Dimensions are 3⅞ inches × 5⅞ inches × 2¼ inches, and the weight is less than one lb.
Price: The Speco Model F-60 Multitester sells for $66.55.

Circle 65 on literature card

Portable Multitester

Product: Model THL-33
Manufacturer: Speco
Function and/or Application: Measures DC and AC volts, resistances, DC currents, and decibels.
Features: The meter is fused for protection, the case is of metal for durability, and all the ranges can be selected by one rotary switch.
Specifications: The ranges are: **5 AC and DC voltage ranges,** from 10 volts full scale to 1000 volts full scale, at 2000 ohms per volt sensitivity; **3 DC current ranges,** from 500 microamperes full scale to 250 milliamperes full scale; **3 resistance ranges,** from 10 ohms full scale to 1M ohm full scale; and **2 decibel ranges,**

from −20 dB to +36 dB. Dimensions are 3½ inches × 5 inches × 2 inches.
Price: Model THL-33 sells for $24.95.

Circle 66 on literature card

Clamp-type Tester

Product: Model WV-526A Clamp Tester by RCA Electronic Components
Features: Measures up to 300 amperes of AC current without direct connection. The insulated clamp is placed around one of

the wires. A "stop-lock" feature holds the reading for as long as required for measurements made in the dark or in positions where the meter could not be seen at the time. By use of test leads, AC voltages up to 600 volts can be measured, and resistances from 1 ohm to 1,000 ohms. A simulated-leather case with a compartment for storage of the test leads is provided.
Price: The RCA WV-526A Clamp Tester sells for $54.00. ☐

Circle 67 on literature card

Circle 34 on literature card

Circle 29 on literature card

product report

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

Clips

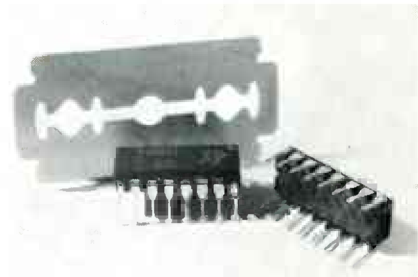
Product: Alligator and general purpose clips
Manufacturer: Vaco Products Co.
Function and/or Application: For quick and temporary connections
Features: Clips are of cadmium finish steel or solid copper in both insulated and non-insulated

styles in various sizes. Alligator clips are insulated and color coded red and black for use in determining positive and negative terminations. The clips are packaged four to a bubble pak card.
Specifications: Not available
Price: Prices start at $.10.

Circle 70 on literature card

Semiconductor Replacements

Product: Integrated circuits, transistor sockets, integrated circuit sockets, silicon damper diodes
Manufacturer: GTE Sylvania
Function and/or Application: Solid-state devices and accessories for replacement.
Features: New types include: ten linear integrated circuits; four pair of transistor sockets; a pair of integrated circuit sockets, and a pair of silicon diodes. The silicon monolithic integrated circuits, available in 14-lead, dual-in-line, and plastic packages are: ECG718, 719, 720, and 722 for use in standard stereo and FM processing functions; ECG721, 723, and 727 stereo and FM preamplifiers; ECG724 emitter coupled or cascode operation from DC to 120 megahertz in industrial communications



equipment; ECG725 dual low noise operational amplifier; and ECG726 wide band amplifier for use up to 20 megahertz.
Specifications: Types ECG 417RP, 418RP, and 420RP are transistor socket pairs designed to accommodate 3 and 4-lead transistors in a variety of case sizes. ECG416RP is a socket pair for mounting 16 pin, dual-in-line, integrated circuits in printed circuit boards. ECG173AP is a

matched pair of ECG173A silicon damper diodes.
Price: Not available

Circle 71 on literature card

Line Voltage Monitor

Product: Model LVS-1 AC line voltage monitor.
Manufacturer: Logitek, Inc.
Function and/or Application: De-energizes power lines when the voltage of a single phase line exceeds a pre-set limit.
Features: Applications include any electrical or electronic system where low voltage could be harmful; these range from industrial machinery to computer operations to communications equipment.
Specifications: Input operating voltage (nominal), 120 volts rms, ±20 per cent; input frequency (nominal), 50/60 Hz, ±20 per cent; input drop-out voltage adjustment range, 90 to 130; pick-up adjustment range, 91-131; output contact, 3 PDT; output contact rating, 10A res; operating temperature, −10 degrees centigrade to +70 degrees centigrade.
Price: The LVS-1 sells for $40.00.

Circle 72 on literature card

Liquid Cement

Product: Zipbond contact cement
Manufacturer: Tescom Corp.
Function and/or Application: Self evident

Features: Zipbond can be applied directly from the 1 ounce squeeze bottle with no premixing. No heat or pressure is needed, the contact cement sets up at room temperature.
Specifications: One drop reportedly covers a 1-inch square area to form a colorless transparent bond.
Price: One ounce of Zipbond sells for $9.95.

Circle 73 on literature card

CCTV Camera

Product: Hitachi TIE-250
Manufacturer: Miida Electronics
Function and/or Application: Industrial security applications
Features: The TIE-250 incorporates integrated circuits, plug-in modules, and a Hitachi 2/3 inch separate mesh vidicon and produces a horizontal resolution in excess of 550 lines.
Specifications: The CCTV camera is switchable to RF or video, measures 3.9 inches x 2.56 inches x 7.87 inches and weighs 3.3 pounds.

(Continued on page 68)

(Continued from page 67)

Price: The TIE-250 sells for $190.00.

Circle 74 on literature card

Aerosol Cleaning Fluid

Product: Slide electronic contact cleaner
Manufacturer: Percy Harms Corp.
Function and/or Application: Cleaner for plastic, rubber or painted surfaces
Features: Slide contact cleaner removes oils, greases, fingerprints, accumulation of dirt, waxy deposits, etc. The cleaner is suggested for use on circuit boards, tape heads, switches, tuners, motors and other components and equipment. Slide is non-conductive, non-flammable and reportedly leaves no residue after evaporation. In injection molding operations this new aerosol will remove traces of silicone mold release agents which may be present on plastic parts after molding.
Specifications: Not available
Price: Slide contact cleaner sells for $3.00 a can.

Circle 75 on literature card

Hook-Up Wire

Product: Twenty-five foot spools of hook-up wire
Manufacturer: Workman Electronic Products, Inc.
Function and/or Application: For use in coupling circuits together
Features: Colors and model numbers available are: AL19, red; AL19, white; AL19, blue; AL19, orange; AL19, green; AL19, brown; and AL19, black.

Specifications: The hook-up wire container is 1 3/8 inches x 3 inches. The wire is 7/22 (22 gauge unistrand) UL approved, can withstand temperatures to 105 degrees centigrade, type FR-1.
Price: Not available ☐

Circle 76 on literature card

Circle 40 on literature card

ELECTRONIC SERVICING

is **your** magazine!

If you would like to see an article about a particular subject directly related to servicing consumer or communications electronic products, send us your suggestion.

We value your comments and criticism.—Ed.

audio systems report

Features and/or specifications listed are obtained from manufacturers reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

VHF-UHF Monitor

Product: PRO-3A VHF-UHF three-band monitor
Manufacturer: Radio Shack
Function and/or Application: Reception of emergency communications
Features: Included: an extra IC in the IF stage for selectivity, full-wave bridge rectifier for better power regulation, added stage in the UHF buffer amplifier for clarity and six added solid-state devices for overall circuitry. A mounting bracket is supplied for mobile use. Operation is either AC or 12VDC and can switch automatically to battery power in the event of an AC failure.

Specifications: The PRO-3A tunes 30-50 M-Hz VHF, 152-174 M-Hz VHF and 450-470 M-Hz UHF for coverage of emergency service (police, fire, utilities) and business frequencies now in use. The receiver has separate tuning dials for VHF-Hi and VHF-Lo/UHF; two antenna inputs; an 8-section crystall filter; 5 KHz and 15 KHz selectivity switch, switchable AF filter. Sensitivity is given as 1 μV for 20 dB quieting. Selectivity: 5 KHz, -6 dB at 5KHz; 15 KHz, -3 dB at 35 KHz. The PRO-3A measures 3 3/8 inches x 12 1/4 inches x 9 1/8 inches.
Price: The PRO-3A monitor sells for $179.95.

Circle 80 on literature card

Low-Noise Tape Cassettes

Product: Red Seal Tape Cassettes
Manufacturer: RCA Electronic Components
Function and/or Application: These cassettes are for audio recording and playback.

Features: The tapes are cobalt energized to provide low noise, high output and extended high-frequency response without changes of the bias. They are available in 30-, 60-, 90- and 120-minute sizes.
Specifications: Not available.
Price: Price of each C-30 cassette is $2.15, C-60 is $3.15, C-90 is $4.15 and C-120 is $4.75.

Circle 81 on literature card

Speaker System

Product: Model 100 "Studio Monitor" speaker system
Manufacturer: Onkyo Sales, Mitsubishi Int'l. Corp.
Function and/or Application: The three-way system is designed for free-standing placement in large room or studio.
Features: The 14-inch woofer cone is moldshaped on a die-cast aluminum frame. The three-way crossover provides transitions at 700 Hz and 7,000 Hz.

Specifications: Frequency response, 20-20,000 Hz; maximum power capacity, 60 watts; minimum amplifier power, 15 watts RMS; impedance, 8 ohms; crossover controls (mid-range and tweeter, in 5 steps each), ±2 dB; speaker complement, woofer, 14 inches; midrange sectoral horn,

(Continued on page 70)

phototip Exchange

Soldering Tip

When you unsolder and remove a lead of a component from a circuit board, insert the tip of a round wooden toothpick into the hole before the solder cools. This will prevent the solder from plugging the hole, and make replacement of the wire much easier.

(Continued from page 69)
4 1/2 inches x 11 inch mouth with Duraluminum diaphragm at 1 3/8 inches; tweeter sectoral horn, 2 inches x 3 1/2 inch mouth with Duraluminum diaphragm at 1 inch; dimensions 28 inches x 27 inches x 17 inches and weighs 83 1/2 pounds.
Price: Model 100 sells for $499.95.

Circle 82 on literature card

Three-Way Speaker

Product: Model AS200 three-way, acoustic-suspension speaker
Manufacturer: Sansui Electronics Corp.
Function and/or Application: Self evident
Features: The LC crossover exhibits a 6 dB/octave low-cut character for the tweeter, 12 dB/octave low-cut for the midrange and 12 dB/octave high-cut for the 10-inch woofer. Finished on four sides in open-pore walnut, it can be positioned horizontally or vertically.

Specifications: The frequency range is 40 to 20,000 Hz, and can handle power up to 50 watts peak. Separately variable attenuator controls are provided for the midrange and tweeter drivers. The AS200 measures 12 3/8 inches x 23 15/32 inches x 11 13/16 inches and weighs 34.1 pounds.
Price: Model AS200 sells for $119.95. ☐

Circle 83 on literature card

Send your own Photo-Tip to the editor. Yes, we pay.

Circle 36 on literature card

The MARKETPLACE

This classified section is available to electronic technicians and owners or managers of service shops who have for sale surplus supplies and equipment or who are seeking employment or recruiting employees.

Advertising Rates in the Classified Section are:

- 25 cents per word (minimum $3.00)
- "Blind" ads $2.00 additional
- All letters capitalized—35 cents per word

Each ad insertion must be accompanied by a check for the full cost of the ad.

Deadline for acceptance is 30 days prior to the date of the issue in which the ad is to be published.

This classified section is not open to the regular paid product advertising of manufacturers.

Use your Scope (any model, no rewiring) to Test Transistors Incircuit. Simple instructions $1.00. Schek Technical Services, 8101 Schrider St. Silver Spring, Maryland 20910. 6-72-6t

FOR SALE

FOR SALE—14 pcs. of test equipment with manuals. All the equipment is less than a year old. The first $900.00 takes all. Send self-addressed envelope for list. Daniel Seidler, 5827 S. Campbell Ave., Chicago, Ill. 60629 8-72-2t

TV & RADIO TUBES 36c EA.!! Free color catalog. Cornell, 4221 University, San Diego, California 92105 8-72-6t

FOR SALE: Sams Photofact sets 221 through 1247 in file cabinets. Best offer. A&H Television, 913 S. 5th, Renton, Wash. 98055 8-72-1t

WANTED

WANTED—Electronic Service Technician. TV Audio Expert. Capable of handling all phases of shop work. For Aspen, Colorado. Heart of Colorado ski, fishing and hunting area. Charles H. Littlejohn, 10672 West Alameda, Lakewood, Colorado 80226. 8-72-2t

WANTED—Used picture tube rebuilding machine and equipment. Randolph Electronics, 5496 River Road, Cincinnati, Ohio 45233. 8-72-1t

WANTED—Color picture tube rebuilding equipment. Telephone 716-684-2856. 8-72-2t

Circle 37 on literature card

advertisers' index

catalogs literature

Circle appropriate number on Reader Service Card.

ANTENNAS

100. *Antenna Specialists Co.*—announces a new amateur radio catalog with an expanded line of two meter, six meter, and three-quarter meter amateur base and mobile antennas.

101. *Blonder-Tongue, Inc.*—announces a booklet presenting the basic facts necessary to understand MATV systems. A Glossary of Terms is included for further understanding.

102. *Jerrold Electronics Corp.*—Catalog S, titled "Systems and Products for TV Distribution," lists specifications of this manufacturer's complete line of antenna distribution products, including antennas and accessories, head-end equipment, distribution equipment and components, and installation aids.

103. *Union Metal Manufacturing Co.*—announces a new 8-page catalog that illustrates self-supporting antenna poles up to 250 feet in height, design information for 25 foot through 200 foot poles, pole accessories, foundation specifications and erection information.

AUDIO

104. *Arista Enterprises, Inc.*—announces their 58-page needle and cartridge catalog. The needle cross reference reportedly has up-to-date cross references of all major needle manufacturers, in addition to cross reference sections of phonograph manufacturers' needle and cartridge numbers.

105. *Atlas Sound*—introduces an 8-page color brochure of loudspeakers, paging and intercom speakers, projector horns and drivers, mobile and industrial communications units, hi-fi and sound columns. Included are 100 individual models of loudspeakers and accessories.

CAPACITORS

106. *Cornell-Dubilier Electronics*—has issued an 80-page cross-reference, 1972 catalog for location of single, dual, triple, and quadruple section replacement electrolytics.

107. *Loral Distributor Products*—has made available a 24-page electrolytic capacitor replacement guide. The catalog features replacement products by the original manufacturers part number.

108. *Sprague Products Co.*—has announced a 40-page manual which lists original part numbers for each manufacturer, followed by ratings, recommended Sprague capacitor replacements, and

list prices. More than 2,500 electrolytic capacitors are included.

COMPONENTS

109. *Essex International, Inc.*—the new 64-page Color and Monochrome Television Parts Replacement Guide lists over 500 Stancor transformer and deflection components for 200 television manufacturers. A reported 14,000 replacements for original parts are available.

110. *P. R. Mallory & Co., Inc.*—introduces a 64-page general catalog containing approximately 10,000 items. Included in the catalog are batteries, capacitors, controls, resistors, semiconductors, switchers, and timers plus security systems, cassette recorders and cassette recording tapes.

111. *Precision Tuner Service*—announces a new tuner parts catalog, including a cross reference list of antenna coils and shafts for all makes of tuners.

112. *Workman Electronic Products, Inc.*—has released a 68-page 1972 catalog of replacement components for radio and television. Included are resistors, fusing devices, circuit breakers, sockets, convergence controls, electronic chemicals, audio cables, adapters for hi-fi and cassette type recorders battery holders and prototype kit components.

CONTROLS & SWITCHES

113. *Centralab Dist. Products*—introduces a chart which covers all Fastatch II rotary and push-pull action line switches. Diagrams are illustrated for each switch plus photographs for quick reference guide to replacement push-pull line switches.

FUSES

114. *Littelfuse, Inc.*—announces a 56-page product catalog featuring mechanical and electrical specifications of all types of glass and ceramic tube fuses, fuseholders, fuse clips and blocks, automatic and manual reset circuit breakers, heavy and medium duty relays, alarm buzzers and momentary action switches.

KITS

115. *Heath Co.*—announces their 1972 Heathkit catalog, reportedly featuring over 350 kit projects. Projects for the home, the car, and workshop are included.

MARINE ELECTRONICS

116. *Raytheon Co.*—introduces the Webster antennas and seven new antennas designed for use with standard and single sideband marine radio-telephone and citizens band radios. The Webster antennas for VHF/FM radio are offered in 3 dB, 6 dB, and 9 dB models.

SECURITY ELECTRONICS

117. *Mountain West Alarm Supply Co.*—a 64-page catalog describes and offers over 350 intrusion and fire alarm products. Six-pages of Application Notes for alarm equipment also is included.

SEMICONDUCTORS

118. *Electronic Devices, Inc.*—announces a 4-page catalog on solid-state replacement and renewal parts for color TV receivers including solid-tubes, cartridges and multipliers. Solid-state solid-tube high-voltage rectifiers, focus rectifiers and damper diodes, silicon and selenium focus cartridges, diagrams showing dimensional drawings and socket connections for solid-tube solid-state replacements of vacuum tubes with maximum ratings for pulse rectifier service is also included.

119. *GTE Sylvania*—has published a 12-page supplement, designated ECG 212D-2, cross reference with more than 7,100 industrial part numbers with the Sylvania types which replace them.

120. *International Rectifier Corp.*—announces the new 64-page "Semiconductor Cross Reference and Transistor Data Book," with over 35,000 listings, including 10,000 types not previously shown. Types included are transistors, diodes, zeners, capacitors, rectifiers, and SCRs. A removable wall chart and new products bulletin are also included.

121. *Motorola, Inc.*—announces the 1972 Motorola HEP Semiconductor Cross-Reference Guide and Catalog, featuring approximately 38,000 semiconductor devices to HEP replacements. Included are 1N, 2N, 3N, JEDEC, manufacturers' regular and special "house" numbers and many international devices, with particular emphasis on Japanese types.

122. *RCA Distributor Products*—introduces a 96-page "SK Series Top-Of-The-Line Replacement Guide" (SPG-202M) which cross-references over 46,000 semiconductor device numbers. In addition a Solid-State Quick Selection Replacement Chart (1L1367A) listing entertainment SK-Series devices is included.

123. *Semitronics Corp.*—has a new, revised "Transistor Rectifier, and Diode Interchangeability Guide" containing a list of over 100 basic types of semiconductors that can be used as substitutes for over 12,000 types.

SERVICE AIDS

124. *Castle Television Tuner Service, Inc.*—literature describing the Castle TV Tuner Subber—solid-state, portable unit for field service of color or black and white TV receivers,

125. *Chemtronics*—announces a new 12-page, 1971-1972 catalog of products, including: tuner sprays, circuit coolers, insulating sprays, contact and control sprays, lubricants, tape head cleaners and conditioners, electronic glues and cements, solder, and spray paints.

126. *Kester Solder*—has released an 8-page brochure presenting the company's full line of soldering products. Presented are: "44" resin core solder, acid-core solder, solid-wire, bar solder, TV-radio solder and Metal Mender.

SHOP EQUIPMENT

127. *Kole Enterprises, Inc.*—announces a 36-page color catalog which includes 31 sizes of corrugated stock/parts bins, flat and vertical storage bins, transfer and magazine files and shipping cartons.

SOLID-STATE

128. *Electronic Devices, Inc.*—offers a replacement guide on tubes and parts replaced by the EDI solid-state replacement components for color TV.

129. *International Rectifier*—64-page volume, JD-451, has been revised and lists information on diodes, zeners, capacitors, rectifiers and SCR's. There are a reported 4000 new transistor listings. Specifications, characteristics, tables and wall charts are also included.

TECHNICAL PUBLICATIONS

130. *Howard W. Sams & Co., Inc.*—announces publication of a new 96-page 1972 Technical and Scientific Book Catalog. Described are over 800 hardbound and softbound books which cover "do-it-yourself" titles from the Audel Division, amateur radio publications, audio visual materials, instructor's guides and student workbooks. Titles range from "ABC's of Air Conditioning" to Writer's and Editor's Technical Stylebook".

131. *Sencore, Inc.*—Speed Aligner Workshop Manual, Form No. 576P, provides 20 pages of detailed, step-by-step procedures for operation and application for Sencore Model SM 158 Speed Aligner sweep-marker generator.

132. *Sylvania Electric Products, Inc., Sylvania Electronic Components Div.*—has published the 14th edition of their technical manual, which includes mechanical and electrical ratings for receiving tubes, television picture tubes and solid-state devices.

133. *Tab Books*—has released their Spring 1972 catalog describing over 170 current and forthcoming books. The 20-page catalog covers: schematic/servicing manuals, broadcasting; basic technology; CATV; electric motors; electronic engineering; computer technology; reference; television, radio and electronics servicing; audio and hi-fi stereo; hobby and experiment; amateur radio; test instruments; appliance repair, and transistor technology.

TEST EQUIPMENT

134. *Dynascan Corp.*–announces a new 24-page 2-color catalog of B&K Precision Test Equipment. A total of 21 instruments are reportedly presented; from a Mutual Conductance Tube Tester to a new DC to 10 MHz Triggered Sweep Oscilloscope.

135. *Eico*—has released a 32-page, 1972 catalog which features 12 new products in their test equipment line, plus a 7-page listing of authorized Eico dealers.

136. *Hickok*—has published a 4-page brochure, "Hickok Oscilloscopes," which contains descriptions, specifications and prices for Models 5000A and 5002A oscilloscopes.

137. *Information Terminals*—has introduced a new brochure featuring the M-100 Tension Monitor, the M-200 Torque Tester and the M-300 Head and Guide Gage.

138. *Leader Instruments Corp.*—announces the 1972 Catalog of Leader Test Equipment. Test equipment included is the LBO-301 portable triggered-sweep oscilloscope, LSW-300 new solid-state post injection sweep/marker generator, and the LCG-384 miniportable, solid-state battery operated color-bar generator.

139. *Lectrotech, Inc.* — announces the 1972 catalog. "Precision Test Instruments for the Professional Technician". It contains specifications and prices on sweep marker generator, oscilloscopes, vectorscopes, color bar generators and other test equipment.

140. *Mercury Electronics Corp.*—14-page catalog provides technical specifications and prices of this manufacturers' line of Mercury and Jackson test equipment, self-service tube testers, testers, test equipment kits and indoor TV antennas.

141. *Pomona Electronics*—announces their new 60-page 1972 general catalog of electronic test accessories. The catalog provides illustrations and complete engineering information on all products, including dimension drawings, schematics, specifications, features, and operating ranges.

142. *Signal Analysis Ind. Corp.*—announces a 4-page bulletin describing their Model SAI-42 real time digital correlation and probability analyzer. Computional and averaging flexibility, increased dynamic range, increased time resolution, and dial-in capability are among features described with illustrations of the instrument controls.

143. *Tektronix, Inc.*—introduces a 76-page "New Products"

catalog. Products listed are: automated test systems, computer display terminals, machine control products, and TV test instruments and monitors.

144. *Testline Instruments*—has issued a brochure for their new Model 101 Curve Tracer for checking transistors in- and out-of-circuit. All features, specifications, applications and warranty information are included.

145. *Triplett Corp.*—a 4-page, illustrated, 2-color brochure featuring a new battery-operated, portable Model 603 FET VOM has been introduced. Application data and specifications are included.

146. *Triplett Corp.*—announces a 2-page, 2-color data sheet for Model 6028, a 2¾ digit VOM. Data sheet gives DC volts, AC volts, ohms AC and DC current ranges plus construction information, price and accessories.

147. *Speco Components Specialists, Inc.*—announces their 43-page, 1972 catalog of VOM multitesters and meters for TV technicians. Individual features and specifications for each instrument are included.

TOOLS

148. *Brookstone Co.* — announces a new 48-page, 1972 catalog which includes 185 new, unusual and useful hard-to-find tools, plus hundreds of other versatile hand tools and small power tools.

149. *Chapman Manufacturing Co.*—offers a pamphlet containing their line of tools and tool kits. Kit No. 6320, the Midget Ratchet is featured along with other available tool kits.

150. *Ideal Industries*—introduces a 2-page, 4-color brochure announcing their new Heat Gun. Performance characteristics applications, operating features, specifications and ordering information reportedly are included.

151. *Jensen Tools and Alloys*—has announced a new catalog No. 470, "Tools for Electronic Assembly and Precision Mechanics." The 72-page handbook-size catalog contains over 1,700 individually available items.

152. *Plato Products, Inc.*—introduces a 28-page, 2-color soldering tip catalog, No. 0372. Illustrated with dimensioned drawings to facilitate accurate selection, the new catalog features tips to fit leading brands and models of soldering irons.

153. *Upson Tools, Inc.*—Catalog No. 72 contains many new service kits and metric tools. The complete line of 4-in-1 tools offers 16 combinations of double-ended screwdrivers and a variety of nutdrivers.

154. *Vaco Products Co.*—has issued a 12-page price schedule for all Vaco tools. Stock number, description, and list price on each item is given.

155. *Xcelite, Inc.*—Bulletin N770 describes this company's three new socket wrench and ratchet screwdriver sets.

TRANSFORMERS/COILS

156. *Essex Controls Division*—new Stancor Transformer Catalog No. 207 lists over 1,900 standard transformers for design engineers. Full technical data, mounting dimensions, photographs and other specifications on the line of audio transformers, power transformers, chokes and inductors are included. A complete listing of all Stancor sales offices and stocking warehouses is included.

157. *J.W. Miller Co.*—announces a new 92-page radio and TV replacement coil cross reference guide for known domestic and foreign color and black and white TV sets, home and car radios. Over 22,000 replacement coils for 327 manufacturers names reportedly are listed.

158. *Stancor Products*—pocket-size, 108-page "Stancor Color and Monochrome Television Parts Replacement Guide" provides the TV technician with transformer and deflection component part-to-part cross reference replacement data for over 14,000 original parts.

TUNER REPAIR

159. *PTS Electronics, Inc.*—62-page catalog with over 600 exact-replacement tuners listed under their original manufacturer number for ease of exchange. A replacement guide for antenna coils and shafts is also provided.

TV ACCESSORIES

160. *Telematic*—introduces a 14-page catalog featuring CRT brighteners and reference charts, a complete line of test jig accessories and a cross reference of color set manufacturers to Telematic Adapters and convergence loads.

TV PICTURE TUBES

161. *GTE Sylvania*—50-page brochure which describes characteristics of over 900 television picture tubes, plus data on interchangeability information and tips on installation and handling of TV picture tubes.

162. *GTE Sylvania, Inc.*—has published an interchangeability guide listing 191 commonly used color TV picture tubes which can be replaced with 19 GTE Sylvania Color Bright 85® types. □

Send Your Own Photo-Tip To The Editor Yes— We Pay

What do RCA SK series devices have that other replacements don't?

QUALITY PRODUCT

- Top-of-the-line quality
- Meet-or-beat specs
- 23 new types
- Now 120 SKs replace more than 46,000 devices

SOLID-STATE HARDWARE

- 10 sockets for transistors and IC's
- 15 heat sinks from TO-18 to TO-3 package styles

INFORMATION SUPPORT

- Accurate • Comprehensive
- New SK Replacement Guide
- New SK Wall Chart
- Transistor Tape/Slide Educational Shows
- Manuals

All three make up the RCA Solid-State System — a product and back-up approach to a replacement line of devices with the professional technician and service dealers' needs in mind. You put the elements together — and they work. Product is top-of-the-line. Literature is accurate and comprehensive, and hardware helps in your day-to-day servicing.

Remember, RCA's Solid-State System is based on premium product — more than 120 different devices (including 23 brand new ones) that can replace more than 46,000 units, both foreign and domestic. They cover the full range of replacement needs — from small signal types, integrated circuits, insulated gate and junction type FET's, to the newest silicon audio 100-watt output types.

Designed especially for replacement use, RCA SK units are backed by electrical characteristics that make them comparable to or better than original devices. There are no cast-offs or factory seconds.

All units and the types they replace are cross-referenced in the RCA Replacement Guide, SPG-202M. There's a Quick-Selection Wall Chart, too, 1L1367A, and new Audio-Visual service aids. These spell the industry's finest informational backup for replacements — all SK, all available from your RCA Distributor. See him today for your copies.

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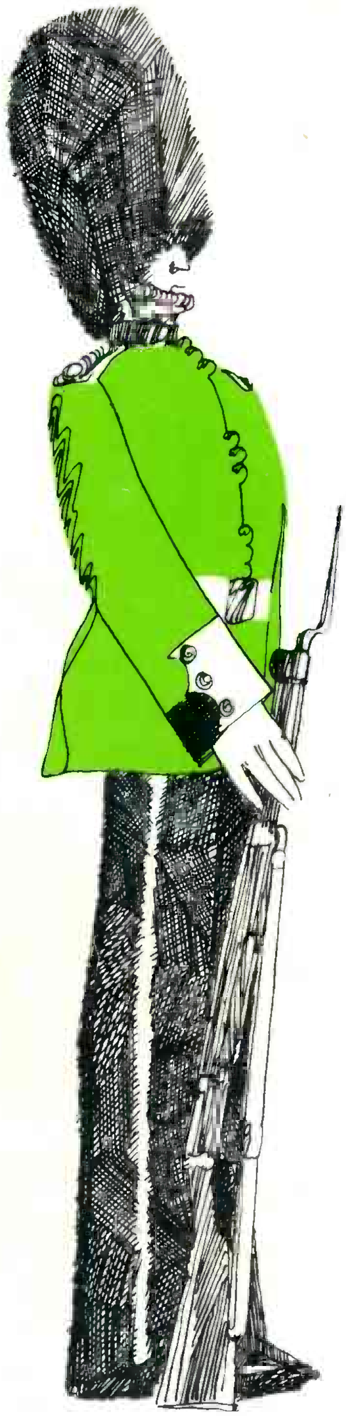
24 hour watch



Everyday. All over the world. On millions of television sets, our sentry stands. The new Littelfuse Circuit Breaker. Meeting industry's new safety requirements of SE-O insulating materials, our breaker is demanded by virtually all set manufacturers. It's the perfect replacement part too!

Contact your nearest Littelfuse source. He'll show you the 19 available models with a variety of packaging choices.

24 hour watch. All over the world. It's a big assignment. But the Littelfuse Sentry is one of television's brightest stars.

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