June, 1975 □ 75 cents

Electronic Servicing

A HOWARD W. SAMS PUBLICATION ®

WIDENING SERVICE HORIZONS

Op-Amps... Solid-State Versatility

FM-Stereo Adjustments

Modular TV Repairs

June, 1975 Volume 25, No. 6

Electronic Servicing®

in this issue...

DEPARTMENTS

ABOUT THE COVER

(Courtesy of Piper Aircraft Corporation)

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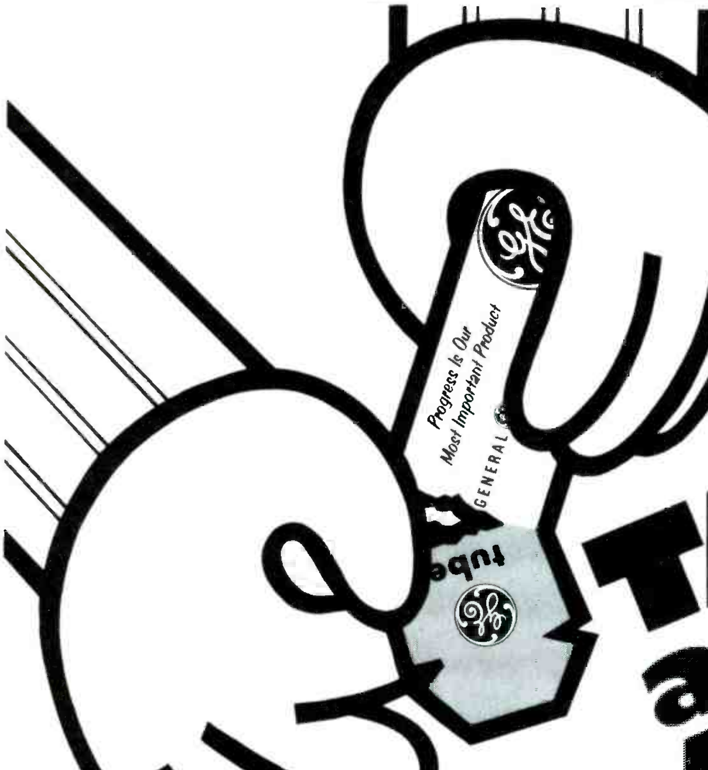
BOTTOMS UP



TAKE GE and Award Yourself!

Back by popular demand, GE Tube presents the 1975 version of BOTTOMS UP. It's *your* chance to cash in on a great gift bonanza, from now through November 30.

Start saving those familiar gray flaps (with the GE monogram) from the bottom of GE tube cartons. Also save the red or blue warranty serial number stickers (with GE monogram) from GE ULTRACOLOR® and Spectrabrite® color picture tubes. (One of these stickers is worth 20 gray receiving tube flaps. **75 flaps equal one book of S & H Green Stamps.)**

Your authorized GE Tube distributor has all the details in a colorful catalog crammed full of the gifts you want. He's waiting for you to come in and pick up your copy.

Your current inventory counts, so start saving *now*—and keep buying GE replacements to boost your total points. Get the details from your authorized distributor; he'll show you how to tear the bottom off GE!

BOTTOMS UP

electronicscanner

news of the industry

The new CardioBeeper enables a doctor to monitor a patient's heart condition during a telephone call. These monitors, each weighing 5 ounces and the approximate size of a pack of playing cards, use integrated circuits developed by ITT Semiconductors, and they are manufactured by Survival Technology. A plastic sensor is placed in each armpit; and no paste or strap is necessary. The monitor amplifies the electrical signals from the heart and converts them to audio tones that can be heard over a phone. There are two types of monitor. One is for a patient whose heart condition requires frequent testing by a doctor. The other is especially for a patient who has had a pacemaker implanted in the chest; the patient tests the rate of heartbeat and reports any abnormality to his doctor. A monitor should provide about 50 hours of operation from the internal 9-volt standard radio battery.

Colorado Intercable intends to install in the Denver, Colorado area a receiving station for signals from a synchronous communication satellite to be launched in January of 1976 by RCA Global Communications. (See "TV From Satellite To Home", page 12, July, 1974 **Electronic Servicing.**) This link eventually will enable Colorado Intercable to provide pay-television programs for its subscribers.

Italy will have color TV by the end of 1975. After 10 years of debate over which system to choose, the German PAL system has been selected. Italy also has Cable TV and a magazine devoted to CATV, CCTC, and A.V. The new magazine is called **Millecanali TV,** which means "one-thousand channels".

Panasonic has developed a Bucket-Brigade Device (BBD) that delays audio frequency signals. Electric signals sampled by clock pulses are transferred from a capacitor at the input to one at the output through a combination of capacitors and transistors like a bucket relay. One capacitor and one transistor make up a "stage"; the more stages, the longer the time delay. The MN3001 model has 512 stages. Among the many potential uses for the device is all-electronic reverberation.

Color TV manufacturers were wrong to reduce warranties, said Paul Goldenberg, keynote speaker at the NARDA annual meeting in San Antonio, Texas. According to **Home Furnishings Daily,** Goldenberg said the change in warranties from one year to 90 days on solid-state color sets will result in a decline in consumer confidence and sales. Goldenberg, who operates Paul TV and Appliances in La Habre, California, said manufacturing costs could have been reduced other ways, rather than by taking away the dealer's Number 1 selling tool, the warranty.

Delco Electronics Division has been authorized by General Motors to establish an Integrated Circuit Design Center to provide electronics expertise to other GM divisional and staff operations. This move illustrates the growing importance of electronics in the automobile industry.

(Continued on page 6)

TUNER SERVICE CORPORATION

SUBSTITUNER

INTRODUCING AT JUST $39^95 U.S.A. ONLY

WITH CABLES

ONE YEAR GUARANTEE

STILL ONLY $9^95 U.S.A. ONLY

ALL PARTS INCLUDED

EXCEPT TUBES AND TRANSISTORS

FEATURES

- A UHF Tuner with 70 channels which are detented and indicated just like VHF channels.
- A VHF Hi Gain Solid State Tuner.
- AC Powered
- 90 Day Warranty

Demonstrate the **SUBSTITUNER** to your customers and show improved reception with their TV sets.

You may place your order through any of the Centers listed below.

PROVIDES YOU WITH A COMPLETE SERVICE FOR ALL YOUR TELEVISION TUNER REQUIREMENTS.

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UHF/VHF COMBINATION .... (U.S.A. ONLY) $15.00

- IN THIS PRICE ALL PARTS ARE INCLUDED. Tubes, transistors, diodes, and nuvistors are charged extra. This price does not include mutilated tuners.
- Fast, efficient service at our conveniently located Service Centers.
- All tuners are ultrasonically cleaned, repaired, realigned, and air tested.

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UNIVERSAL REPLACEMENT TUNER $12.95 (U.S.A. only)

- This price buys you a complete new tuner built specifically by Sarkes Tarzian Inc. for this purpose.
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- Specify heater type parallel and series 450 mA. or 600 mA.

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- Customized tuners are available at a cost of only $15.95. With trade-in $13.95. (U.S.A. only)
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MISSOURI	ST. LOUIS, MISSOURI 63132	10530 Page Avenue	Tel. 314-429-0633
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NEW JERSEY	TRENTON, NEW JERSEY 08638	901 North Olden Avenue	Tel. 609-393-0999
	JERSEY CITY, NEW JERSEY 07307	547-49 Tonnele Ave., Hwy. 1 & 9	Tel. 201-792-3730
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	CLEVELAND, OHIO 44109	4525 Pearl Road	Tel. 216-741-2314
OREGON	PORTLAND, OREGON 97210	1732 N.W. 25th Avenue	Tel. 503-222-9059
TENNESSEE	GREENEVILLE, TENNESSEE 37743	1215 Snapps Ferry Road	Tel. 615-639-8451
	MEMPHIS, TENNESSEE 38111	3158 Barron Avenue	Tel. 901-458-2355
TEXAS	DALLAS, TEXAS 75218	11540 Garland Road	Tel. 214-327-8413
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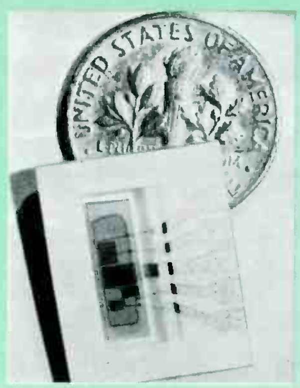
	CALGARY, ALBERTA T2H-OL1	448 42nd Avenue S.E. P.O. Box 5823, Stn. "A"	Tel. 403-243-0971

IF YOU WANT TO BRANCH OUT INTO THE TV TUNER REPAIR BUSINESS, WRITE TO THE BLOOMINGTON HEADQUARTERS ABOUT A FRANCHISE.

For More Details Circle (4) on Reply Card

(*Continued from page 4*)



(Courtesy of Zenith)

Acoustic-Wave and solid-state principles are combined in this surface-wave integrated filter that replaces 12 separate parts in the intermediate-frequency section of a color TV set. The filter was developed at Zenith's Microcircuit Facility, and tests indicate the device will reduce the number of adjustments in production, provide more stable reception of TV signals, and help eliminate TV IF adjustments during the life of the set.

A tiny electronic device called a microprocessor is achieving significant gasoline savings in tests conducted by major automobile manufacturers, stated RCA Chairman Robert W. Sarnoff in a recent speech. **Radio & Television Weekly** reports that preliminary tests show the device can boost mileage by up to 40 percent in standard and large size cars. The microprocessor is a miniature computer containing 6,000 transistors and other devices that automatically will adjust both choke and throttle for maximum starting efficiency, run the motor at the correct fuel mixture for fuel savings, and shift gears at the right time for best fuel efficiency.

Hitachi has completed a transistor-assembly system that automatically manufactures transistors. The system has a minicomputer, image processors, and wire-bonding machines with visual functions to determine chip positions of transistors fed into the machines. A microscope and TV camera are mounted on each wire-bonding machine, and the image signal from the camera is analyzed by a combination of the image processor and the computer to give position recognition in .2 seconds per chip. Commands are fed back from the computer to the appropriate wire-bonding machine, which stretches the gold wire between the emitter and base electrodes on the chip and the corresponding outer leads. This method has increased the production rate by more than twice that of traditional operations.

"It's perfectly obvious that there will be more big losses, bankruptcies, and companies being bought out if there aren't price increases in color TV in June", said John J. Nevin, president of Zenith Radio Corporation recently. According to Nevin, the brunt of the recession appears to be over for Zenith, and the nation's TV manufacturers, reports **Home Furnishings Daily.** The short-term outlook is far more encouraging than it was three months ago, said Nevin. □

The test set by which to judge all tv sets.

New RCA ICTJ,
Model 10J106

INTRODUCING THE ALL-NEW
RCA Industry Compatible Test Jig

Here's a test jig engineered for use with virtually all television receivers: the RCA 10J106. To assist your servicing efforts, not only will it judge the performance of practically every RCA color chassis built in the last decade — tube type, hybrid or solid state — but readily available pin connection adapters permit testing of almost every other leading TV chassis. RCA's 10J106 is destined to become the standard of the service industry.

Check these features:

- A 19" picture tube with 33 KV capability.
- A simple 2-switch system for matching yoke impedances. No additional transformers to buy or plug in.
- A built-in high voltage meter calibrated to 35 KV, red-lined at 33 KV for safety. Built-in static convergence, and built-in matching transformer for 9 different horizontal deflection outputs.
- 5-step vertical matching transformer matches virtually all TV chassis.
- Lightweight, portable cabinet with convenient handle.
- Accessories included for RCA sets: two 4-ft. cables for kines and yokes; molex to octal adapter; special yoke adapter; two convergence loads for RCA chassis; high voltage lead; ground lead; audio cable and speaker; high voltage extension cable; continually-updated Cross Reference Handbook; set-up and instruction manuals.

Call your RCA Distributor. He's waiting to hear from you. Or contact RCA Distributor and Special Products Division, Cherry Hill Offices, Camden, N.J. 08101.

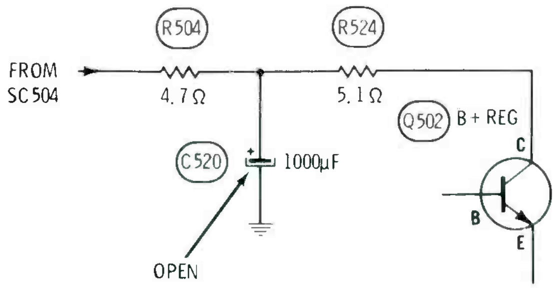
RCA Distributor and Special Products Division

For More Details Circle (5) on Reply Card

symcure

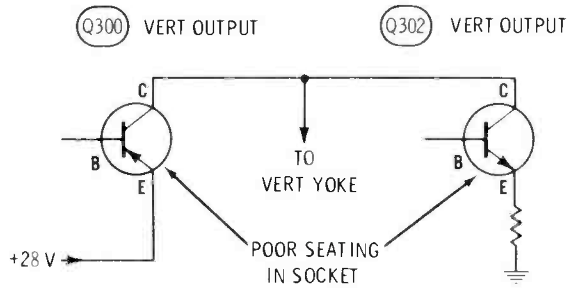
Symptoms and cures compiled from field reports of recurring troubles

Chassis—Sylvania E06
PHOTOFACT—1432-3



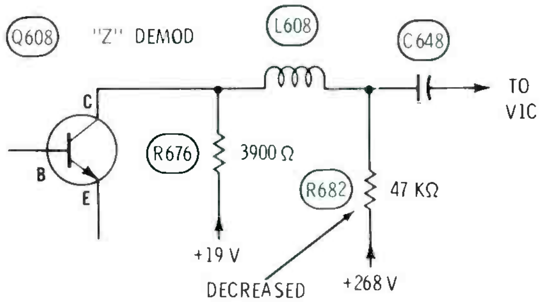
Symptom—No sound or picture; horiz output transformer whistles
Cure—Check filter capacitor C520, and replace it if open

Chassis—Sylvania E06
PHOTOFACT—1432-3



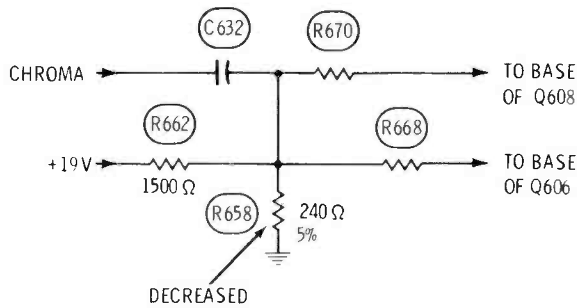
Symptom—White horiz line at top or bottom of picture
Cure—Check for poor seating of vertical-output transistors in the sockets

Chassis—Sylvania D16
PHOTOFACT—1325-2



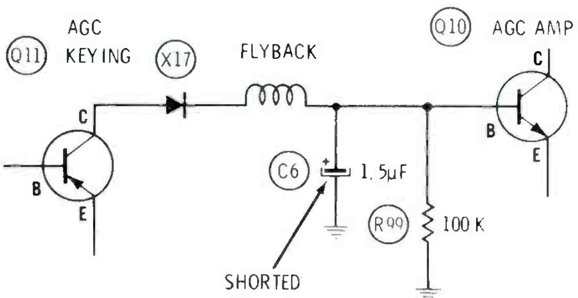
Symptom—Internal oscillations interfere with other sets
Cure—Check R682, and replace it if decreased in value

Chassis—Sylvania D16
PHOTOFACT—1325-2



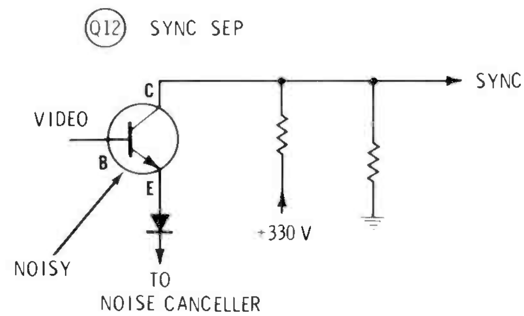
Symptom—No chroma, or weak chroma
Cure—Check R658, and replace it if decreased in value

Chassis—Sylvania D12
PHOTOFACT—1143-1



Symptom—AGC overload
Cure—Check C6, and replace it if leaky or shorted

Chassis—Sylvania D12
PHOTOFACT—1143-1



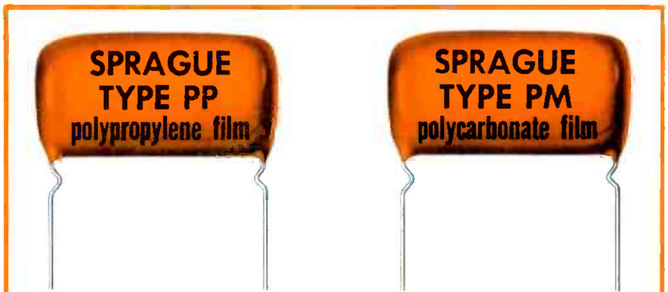
Symptom—Noise in picture, radiates to other sets
Cure—Check Q12, or replace it on suspicion

Avoid serious problems when replacing film capacitors

Use genuine Sprague Type PP and PM Capacitors in critical deflection circuits.

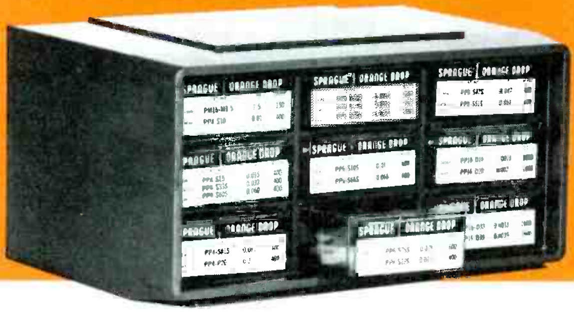
The next time you replace a dipped tubular in one of the newer color TV sets, don't automatically assume you're replacing an ordinary every-day film or paper capacitor. If it happens to be a deflection capacitor used for commutation or S-shaping, you need a polypropylene or polycarbonate film replacement with (1) high a-c current-carrying capability; (2) close capacitance tolerance; (3) good capacitance stability. The standard replacement capacitors used in the industry, even our superior Type PS dipped tubulars, just won't do the job . . . they could cause the set to become inoperative again.

Play it safe . . . dipped tubulars may look alike on the surface, but there can be a *big* difference in the film dielectric. Keep a supply of Sprague Type PP and PM capacitors on hand for those critical situations where ordinary replacements could cause serious problems.



SPECIAL DEFLECTION CAPACITORS FOR COMMUTATING AND S-SHAPING

A Service Technician Introductory Super Special . . .



the KF-28 ASSORTMENT

. . . a total list price value of $65.00 . . . with a regular dealer net of $35.95 . . .

for a low, low $25.20 dealer net

Be ready for those critical application replacements in today's color TV sets with the KF-28 Assortment. It contains 41 Type PP and PM polypropylene and polycarbonate capacitors in 20 popular ratings, stocked in a handy cabinet that puts the film capacitors you need at your fingertips, neatly organized and easy to find. Measuring 9¾" wide x 5" high x 6½" deep, this attractive blue 9-drawer cabinet has clear plastic drawers with adjustable dividers. Prelabeled drawer fronts identify the capacitors inside. A raised area on top of the cabinet and a depression in the bottom facilitate stacking of two or more cabinets.

Get a KF-28 Assortment from your Sprague distributor today!

ASSORTMENT KF-28 CONTENTS

Quan.	μF @ WVDC	Cat. No.	Quan.	μF @ WVDC	Cat. No.
2	1.5 @ 150	PM15-M1.5	2	.01 @ 600	PP6-S10S
2	.01 @ 400	PP4-S10	2	.066 @ 600	PP6-S66S
2	.015 @ 400	PP4-S15	2	.075 @ 600	PP6-S75S
2	.033 @ 400	PP4-S33S	2	.022 @ 800	PP8-S22S
2	.06 @ 400	PP4-S60S	2	.047 @ 800	PP8-S47S
2	.081 @ 400	PP4-S81S	2	.051 @ 800	PP8-S51S
2	.2 @ 400	PP4-P20	2	.0018 @ 1600	PP16-D18
2	.0018 @ 600	PP6-D18S	2	.002 @ 1600	PP16-D20
2	.0022 @ 600	PP6-D22S	2	.0033 @ 1600	PP16-D33
3	.0039 @ 600	PP6-D39S	2	.0039 @ 1600	PP16-D39

For cross-reference information on close-tolerance polypropylene and polycarbonate film capacitors, showing original part numbers with correct Sprague replacements, ask your Sprague distributor for Cross-Reference Guide C-873, or write to: Sprague Products Company, 105 Marshall Street, North Adams, Mass. 01247.

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For More Details Circle (6) on Reply Card

Through the sky to a $1,700,000 BUSINESS

By Michael Lipman

It's not what you spend for equipment that's important, but how much the equipment saves you. That seems to be the philosophy of George Fletcher; he's the only electronic-service businessman I know who regularly uses an airplane for service and installation work.

George Fletcher and some of his technicians pose in front of his Piper Aztec E plane to show the employees and material that can be transported economically to distant jobs.

If you sometimes refuse a service call because it's across town from your shop, you might think that George Fletcher is somewhat eccentric. George, founder of G&R Service Company of Philadelphia, Pennsylvania, often travels 100 miles or more to repair some item of electronic equipment. Of course, you won't find him racing along the highway in a service truck. Mr. Fletcher is a licensed pilot who flies his sleek twin-engine Piper Aztec E airplane to all repairs beyond the local routes.

One destination is Newark Airport, some 70 miles away. George can fly there in about 15 minutes. G&R Service maintains the National Airlines' information display system (closed-circuit TV) in the New Jersey airline terminal. At least every 60 days, G&R checks out the system. The contract also calls for 24-hour service if a breakdown occurs.

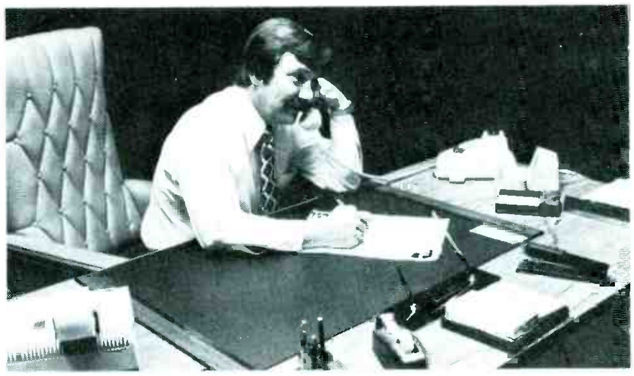
Does it pay dividends to use a plane in this way? Well, for George Fletcher and his G&R Service it has brought phenomenal business growth.

A Modern Horatio Alger Story

In 1966, George Fletcher owned $500 worth of equipment, and was repairing TV receivers in his basement. That same year he landed TV warranty-service contracts from Magnavox. He hired two technicians, and bought a service truck. However, the warranty calls were scattered, and many extra travel miles were required.

Shortly, he could not keep up

G&R technicians load equipment into the rear storage compartment; another storage area is in the nose.



Mr. Fletcher is equally at home in the "cockpit" of his office desk.

with the need to move his men rapidly enough in his constantly-expanding service area.

Three years ago, Mr. Fletcher found the right solution: he would learn to fly, and move his men from job to job by plane.

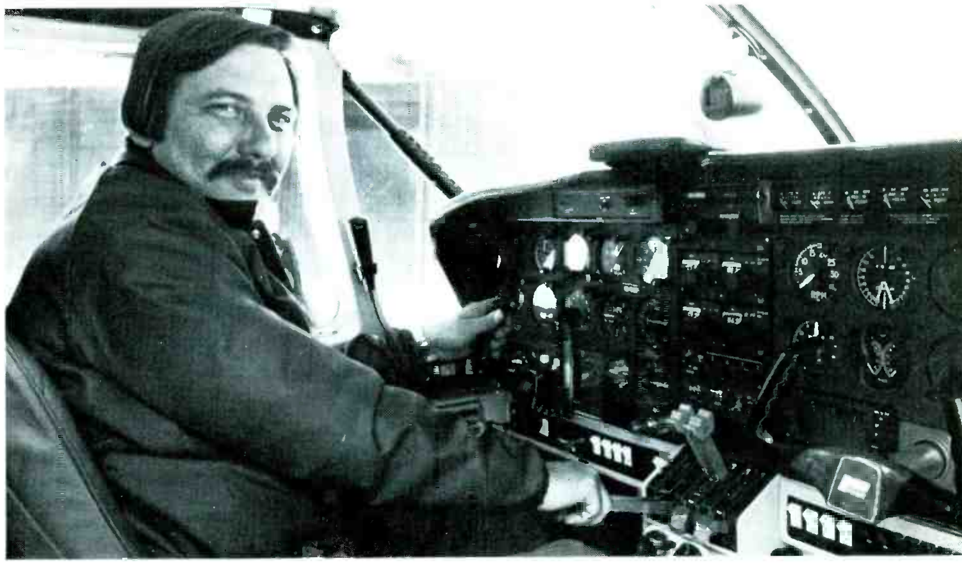
He bought a Piper Cherokee, which can cruise at 141 miles-per-hour and land at thousands of airports too small for the airliners. The Cherokee carried him to most of his long-distance service calls in 45 minutes or less. His unique approach paid off in much new business.

In fact, it paid off so well that he outgrew the Cherokee. Some jobs required him to transport five men and electronic equipment to the customer's location. That's when he bought a Piper Seneca, a seven-seater that winged his crew to jobs at 186 miles-per-hour.

Since then he traded up to a Piper Aztec, which seats six, flies at speeds up to 216 MPH, and carries a load of more than 2100 pounds.

The Sky Is The Limit

With this new-found traveling speed and flexibility, G&R is able to take on larger work loads. Today, the company has service contracts with Magnavox, Zenith, Philco, several chain stores, and hotels and motels (such as Holiday Inn and Howard Johnson's). Fletcher's file of customers has grown from one dealer account to thousands. He has opened a second location in Maple Shade, New Jersey, to service equipment in the Garden State. The company will do



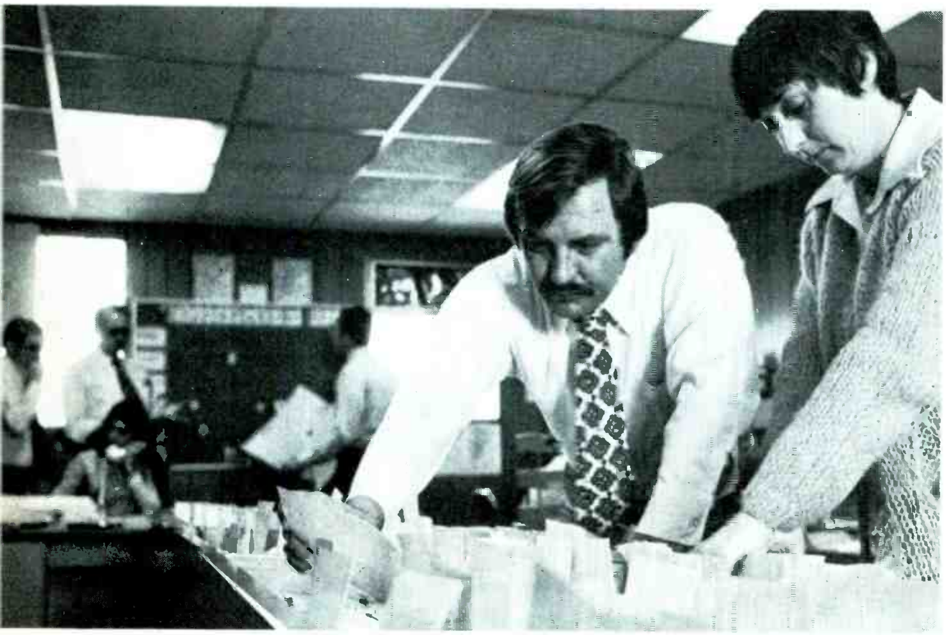
George Fletcher goes through the pre-flight checklist before taking off.

The story of George Fletcher, who in 9 years expanded from a basement one-man shop to a multi-million-dollar service business, makes fascinating reading. It shows what a person can do by using imagination, resourcefulness, and drive. More importantly, it should inspire you to plan and dream about other ways of rising above the average humdrum business life, while remaining in your chosen field of electronics.

Using an airplane for service transportation would not be the answer for all operations. But let it be an example of the kind of thinking that can lead to solid success.

For information about learning to fly, or the cost of using a plane for business, write to: Business & Fun Flying, Room 2000, 866 Third Avenue, New York City, New York 10020.

George Fletcher and Don Campanile (Vice President) are shown checking a computer readout.



All service records are transferred to cards, which are kept in sequence in several filing tables.

Joe Foley discusses a service problem with Mr. Fletcher in the G&R well-equipped shop area.

anything electronic, from repairing a single TV receiver to designing and installing large MATV systems.

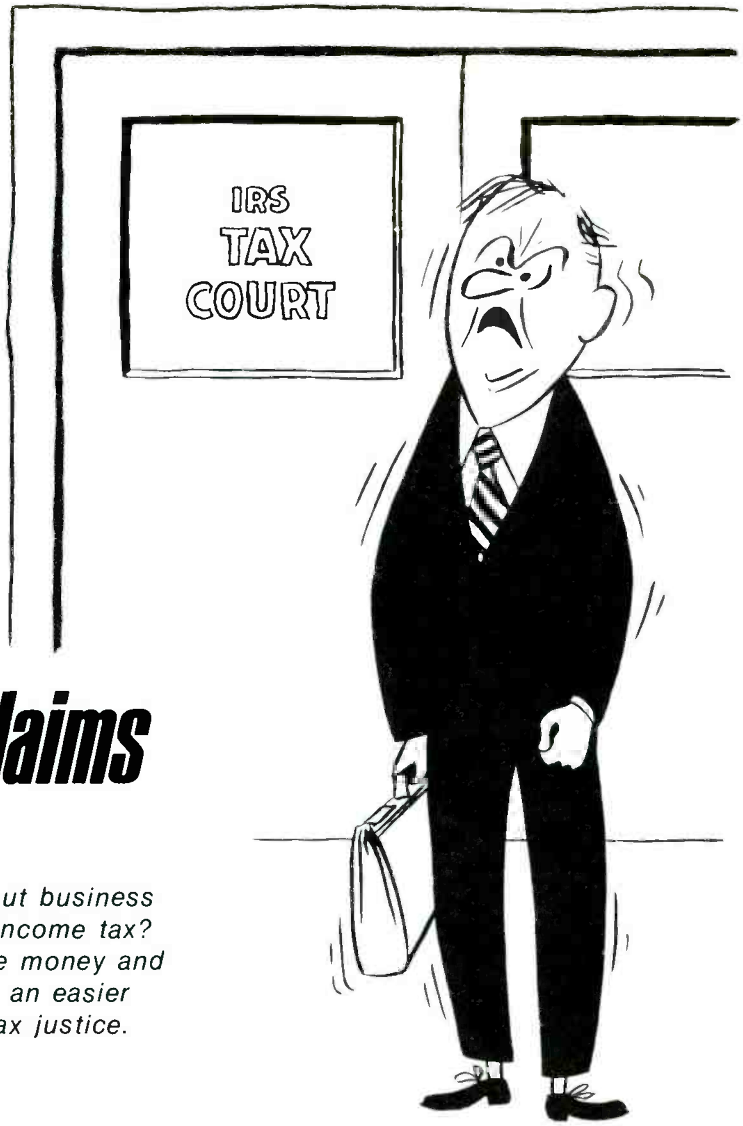
"I could not begin to keep up this pace without my Piper," explained Mr. Fletcher. "Actually, I don't use the plane too often to work on a single TV set, although I will do it to honor a service contract. But we do a lot of commercial work that requires crews of four or five men. Could you imagine my crews driving two-hundred or three-hundred miles to each job? I can fly them there in my plane in an hour and a half. When a crew is finished with one job, I pick them up and fly them to the next location. So, I save a lot of time and money."

The radius of Mr. Fletcher's business now has grown to 900 miles, and includes parts of Pennsylvania, New York, New Jersey, Ohio, Maryland, and Virginia. And, to keep up with all the work in that large area, G&R Service now employs 100 people, uses 44 vehicles for local transportation, grossed more than $1,700,000 last year, and has a $25,000 in-house computer to handle the paper work.

"Thanks to the mobility my Piper Aztec provides," he said, "my business is growing in leaps and bounds. It should double by next year. Very soon I expect to handle service over the entire East Coast. In fact, with my highway in the sky, I can go anywhere to fix a TV set." □

TAX COURT

...Help for small claims



By Louise Brown

Have you ever disagreed with the IRS about business deductions or other items affecting your income tax? Probably you believed it was not worth the money and effort to fight it in court. Here is news of an easier and less-expensive method of obtaining tax justice.

Myron Yourshaw, a slight and unaggressive-looking middle-aged man was almost trembling with rage as he left the Washington, D.C. Tax Court. A professional engineer with the federal Government Services Administration, and the father of five children, Yourshaw was fighting the IRS's claim that he was not entitled to deduct $759 in proprietary drugs (like cough and cold remedies) and $540 of expenses for an office in his home from his 1971 income tax. **Yourshaw was defending his deductions in the Tax Court's small case division,** where tax-payers with disputes under $1,500 can tell it to the judge (in this case, a "commissioner") without hiring expensive lawyers, and for a mere $10 filing fee.

In support of his drug deductions, Yourshaw presented a thousand dollars' worth of ordinary drugstore cash-register receipts, which did not identify the items he had purchased. He pointed out that he was claiming only about $700, because "each member of the family probably used up $100 in these items during the year." When Tax Court Commissioner Charles R. Johnston remarked that drug stores sold many items besides drugs, and asked how many boxes and bottles of the remedies he had bought during the year, or the average prices, Yourshaw could not remember.

Mild-mannered on the witness stand, Yourshaw turned into a tiger outside the court chamber. "The government doesn't care anything about the small taxpayer," he fumed. "We get shafted every time."

Others who told their stories to the commissioner that day do not agree. "I'm satisfied," said Jerry Gushwa, a young purchasing agent grom Gainesville, Va., who was defending his deduction of a legal fee. **"I had my day in court, and whatever the judge decides is all right with me."**

David Christian, a retired foreign services officer from Washington, D.C., also believes that he had a fair hearing. Christian had deducted his personal home-leave expenses as a business expense, in line with a 1972 federal appeals court decision. (The IRS does not consider the decision binding in other cases.) Christian said, "I came away with a very good feeling. I thought the attitude of the commissioner, the lack of formality, and the flexibility were commendable."

"Even the IRS people I met with the day before the hearing were intelligent," he went on. "You could talk to them. The treatment I got earlier from IRS auditors was atrocious."

Until Congress established the small case division of Tax Court five years ago, average taxpayers had no practical, inexpensive way to oppose IRS auditors who hiked their tax bills. People had to hire costly lawyers to represent them in court, or face less-than-disinterested IRS settlement procedures. They had only three alternatives. One was to pay the disputed sum and sue to get it back in a federal district court or the U.S. Court of Claims. Another was to contest the issue in the U.S. Tax Court, and third was to throw themselves on the mercy of IRS employees in "district" and "appellate" conference hearings.

For cases under $1,500, the small-case procedure changes all that. A taxpayer who disagrees with IRS auditors can simply ask the IRS for an official statement of its claims (although it is called a "statutory notice of deficiency," it really is a bill), and then notify the Tax Court in Washington, D.C. that he wants to contest the claim in the court's small case division. He does not have to pay the bill before going to court (although interest will continue to mount up), and he does not have to hire an attorney.

The Tax Court clerk will send the taxpayer a packet containing instructions and a simple five-question petition, in which the taxpayer explains his grievance. **The taxpayer must return the filled-out petition along with a $10 filing fee,** within 90 days after the date on the IRS notice of deficiency. The court clerk lists the cases by city, and the five Tax Court commissioners decide where and when they will hear them. The commissioners visit a total of 110 cities across the nation (although not all of them every year) in an attempt to bring the court as close as possible to the taxpayer's home town.

Before a case actually comes to trial, IRS attorneys try to contact the taxpayer in order to reach a settlement out of court. And, in fact, **most cases are settled this way.** While the small case division heard 391 cases in Fiscal Year 1974, more than four times that number, 1,856, were disposed of by agreement. Another 135 cases were dismissed, mainly because taxpayers did not show up in court.

Most taxpayers do better by settling with the IRS, even at this late stage, **than they do later on in court.** The mere threat of litigation gives the IRS an incentive to reach an agreement which satisfies the taxpayer. In Calendar Year 1973, 1,831 cases were closed this way. Only 286 people paid what the IRS had said they owed.

Of the others, 1,045 paid less than the IRS originally asked and 499 paid nothing at all. One person paid more than the original deficiency. In dollar terms, the IRS claimed $921,636.40 in extra taxes due, but settled for less than half—$427,299.75.

On the other hand, **when cases actually get to court, the IRS is more likely to win,** simply because it does not like to spend money on costly litigation when it might lose. The Tax Court says it does not keep figures on how many cases taxpayers win, but it has released such data in the past. In July, 1972, a syndicated tax columnist, E. Edward Stephens, published figures for the first six months of that year. They showed that taxpayers won their cases less than 10% of the time—9.3% to be exact. The IRS won 67.5% of the cases, and 23.290 were split between the two.

The Tax Court has released recent information about the dollar amounts taxpayers save when their cases come before the court, and the figures are discouraging. The IRS had demanded $218,430 from 391 taxpayers who contested their cases in Fiscal Year 1974, and the court determined that taxpayers owed the IRS 79.2% of that amount—$172,930.

However, taxpayers who do choose to argue their cases in Tax Court feel strongly about the rightness of their cause, and don't care if the odds are against them, according to Commissioner Charles R. Johnston. They want a chance to tell their story in their own words, and they don't want outside help. Commissioner Johnston said that early efforts to provide free legal assistance to taxpayers in the small cases foundered because people preferred to represent themselves.

If recent proceedings in the Washington, D.C. court are typical, it is not a scary thing to do. On the day that Myron Yourshaw told his story, Commissioner Johnston's court was informal and sometimes almost folksy, yet tempered with the solemn dignity of authority.

The small court room with its warm walnut paneling and rich gold draperies is intimate. The American flag stands in one corner and the gold-leafed Tax Court mace (symbol of authority) hangs on a wall behind the judge's elevated bench. Below, six rows of walnut pews provide seating space for some fifty spectators; but only two or three were present. Facing the pews is the judge's bench and, on the same level, a witness box. Below, at the floor level in front of the judge, is a large rectangular table where the deputy trial clerk runs a recording machine and passes documents up to the commissioner. The taxpayer and the IRS attorney would sit at this same table when the trial began.

Commissioner Charles Johnston, an astute and affable man who says he enjoys his work because he had "always felt there should be this kind of forum for small taxpayers," looked down patiently at the participants as the trial started. The taxpayer took his place at the rectangular table and spread out his papers. The young IRS attorney sat nearby with his own, larger stack of documents. Behind him, in the audience, was his superior, George Rabil, from the IRS Regional Counsel's office. Seated behind him were two other young government attorneys, waiting to take part in other cases.

The clerk announced the case and docket number, and the IRS attorney briefly explained the dispute. Then Commissioner Johnston invited the taxpayer to move into the witness box, where he was sworn in, and the dialogue began. **As the taxpayer explained his case, Johnston questioned him closely. He asked for details which would bolster the taxpayer's claims, or, to the contrary, tend to disprove them.** Seated at the same level, although some ten feet apart, the taxpayer and Commissioner Johnston carried on an earnest and personal exchange. After the commissioner completed his questions, the IRS attorney worked to establish his case. He questioned the taxpayer, and described other similar cases which supported the IRS view.

Johnston alternately encouraged ("I am here to help you") and gently chided the taxpayer ("You are asking me to take judicial notice of the state of health of your family, and I cannot do that"). In response to the IRS attorney's recital of case law, Johnston promised the taxpayer some help, "I will research cases which may differ with those mentioned by Mr. ______________", he said.

Finally, Johnston offered the taxpayer time to make a written response to the points the IRS attorney had raised. They settled on a 30-day delay during which the taxpayer could respond. Afterward Johnston would hand down his decision; a decision which the taxpayer cannot appeal.

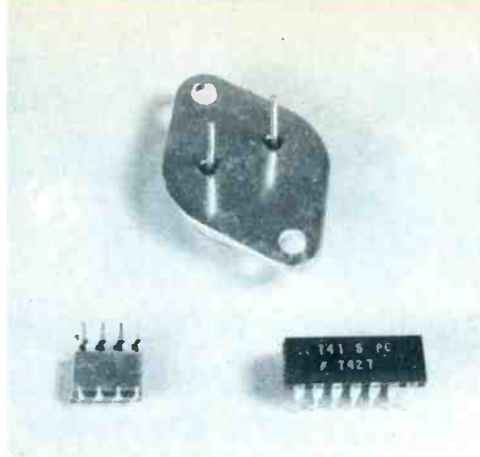
Will the decision be fair? While some critics believe that Tax court commissioners lean toward the IRS, **most observers believe the commissioners call the shots squarely, and that the small-case division is the average taxpayers' best hope for a fair and impartial settlement.** According to L. Hart Wright, a distinguished tax-law professor who has taught law to hundreds of IRS revenue agents, 99% of small taxpayers do not appeal their cases at all, because they cannot afford to hire an attorney, and they do not know the law. They suspect that IRS's own internal hearings are stacked against them. Kenneth R. Kenfield, an Ohio engineer who spent years fighting to deduct an employment-agency fee, told the Wall Street Journal how he felt about the IRS. "It was a lot of trouble. It was lousy," Kenfield told the Journal. "I had to take off work five or six times to go to talk to some guy, and all he could say was I owed them money I didn't really owe them." The newspaper reported that the Tax Court, in a single session, decided he didn't owe it.

Tax Court commissioners know the law, and they do not have an axe to grind. It is hard to imagine why they would subvert the judicial procedure, and it is difficult to think of a better way for taxpayers to have their say. **Until that better way is at hand, taxpayers would serve their own best interests by taking their disputes to this forum.**

OP-AMPS... Versatility in solid state

By Carl Babcoke

Another kind of solid-state device that's finding a welcome in test equipment and consumer-electronic products is the op-amp. The ground rules for best use of op-amps are different from those of transistors, and you should understand the peculiarities before experimenting with them or replacing them in original equipment.



741 op-amps in two different forms are in the foreground, and the power transistor gives an idea of the op-amps small size.

Operational amplifiers (op-amps) were so named because the first huge tube-powered versions were used to perform mathematical **operations** in analog-type computers. Therefore, op-amps are not new, but they have become practical only recently when the many components could be supplied cheaply in small Integrated Circuits (IC's).

Bare characteristic data about op-amps gives little idea of the many different electronic jobs they can do. One book showed 49 different circuits designed around op-amps. They can function as simulated inductors, tuned circuits, notch filters, sine-wave generators, low-distortion audio amplifiers, and many more.

We will not attempt to analyze the internal components or functions of op-amps. Instead, they will be treated as "black boxes" having certain characteristics. The first step in understanding op-amps is to know what attributes "perfect" op-amps should have.

Textbook Op-Amps

Op-amps are direct-coupled linear amplifier gain-blocks having these ideal, or theoretical, specifications:

- Infinitely-high input impedance (input can't accept current, or originate a voltage);
- infinitely-wide bandwidth;
- zero output impedance;
- zero output DC voltage (output offset);
- zero internal noise level;
- zero drift of characteristics with temperature changes or time;
- infinitely-high open-loop gain (without feedback); and
- perfect stability with any amount of feedback.

Of course, the real-world op-amps fall short of these ideals, but the specs tell us many of the attributes that are desired.

Several of the specifications would be easier to obtain with cascaded amplifier stages using normal transistors. So, in order to understand why op-amps became what they are, we must know some of the original jobs done by op-amps.

The first requirement was for an amplifier whose gain depended solely on the ratio of two resistances. Some alternate solutions resulted in excessive noise, overload, self-oscillation, instability and other problems. The best compromise proved to be a high-gain amplifier whose gain was determined almost entirely by negative feedback of an amount selected by two resistances.

Even then tradeoffs were necessary. At the high and low extremes of frequency response, all amplifiers introduce phase shift. When the total phase shift reaches 180°, and sufficient negative feedback is added, an amplifier becomes an oscillator. Therefore, many op-amps have frequency compensation built in, usually giving a drastic roll-off of high frequencies. This gives stability and freedom from oscillation, even when large amounts of feedback are used.

For example, the open-loop (no feedback) response curve of the familar 741 op-amp begins to drop drastically above about 3 Hz. That's right, 3 cycles-per-second. Obviously, that spec would not be satisfactory even for audio frequencies! The solution is that it's never operated at high frequencies without feedback, and the feedback flattens the curve (within limits).

Practical op-amps

Modern op-amps evolved into an integrated circuit (IC) with two inputs into a differential amplifier, intermediate amplifiers (often with HF rolloff), followed by a low-impedance output stage (usually an emitter follower). These gave engi-

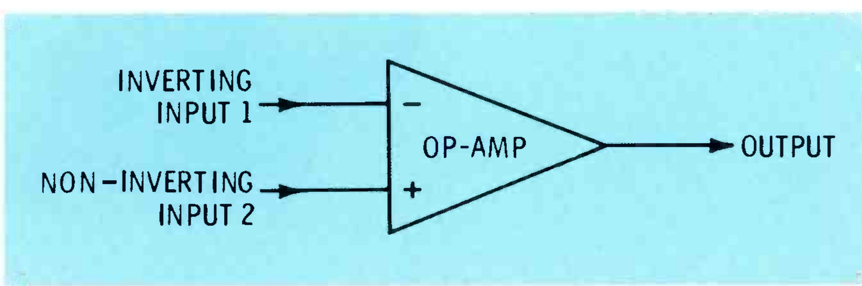


Fig. 1 This is the usual symbol for an op-amp. The polarity signs at the inputs do not refer to the DC voltage, but indicate the polarity of signal at the input which gives a positive-going output signal.

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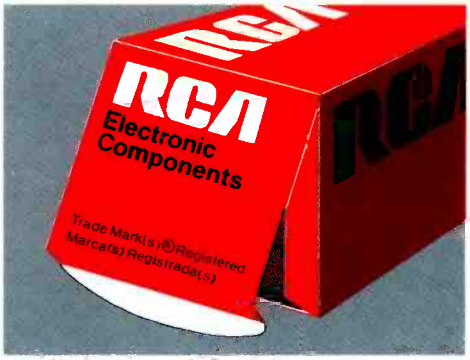

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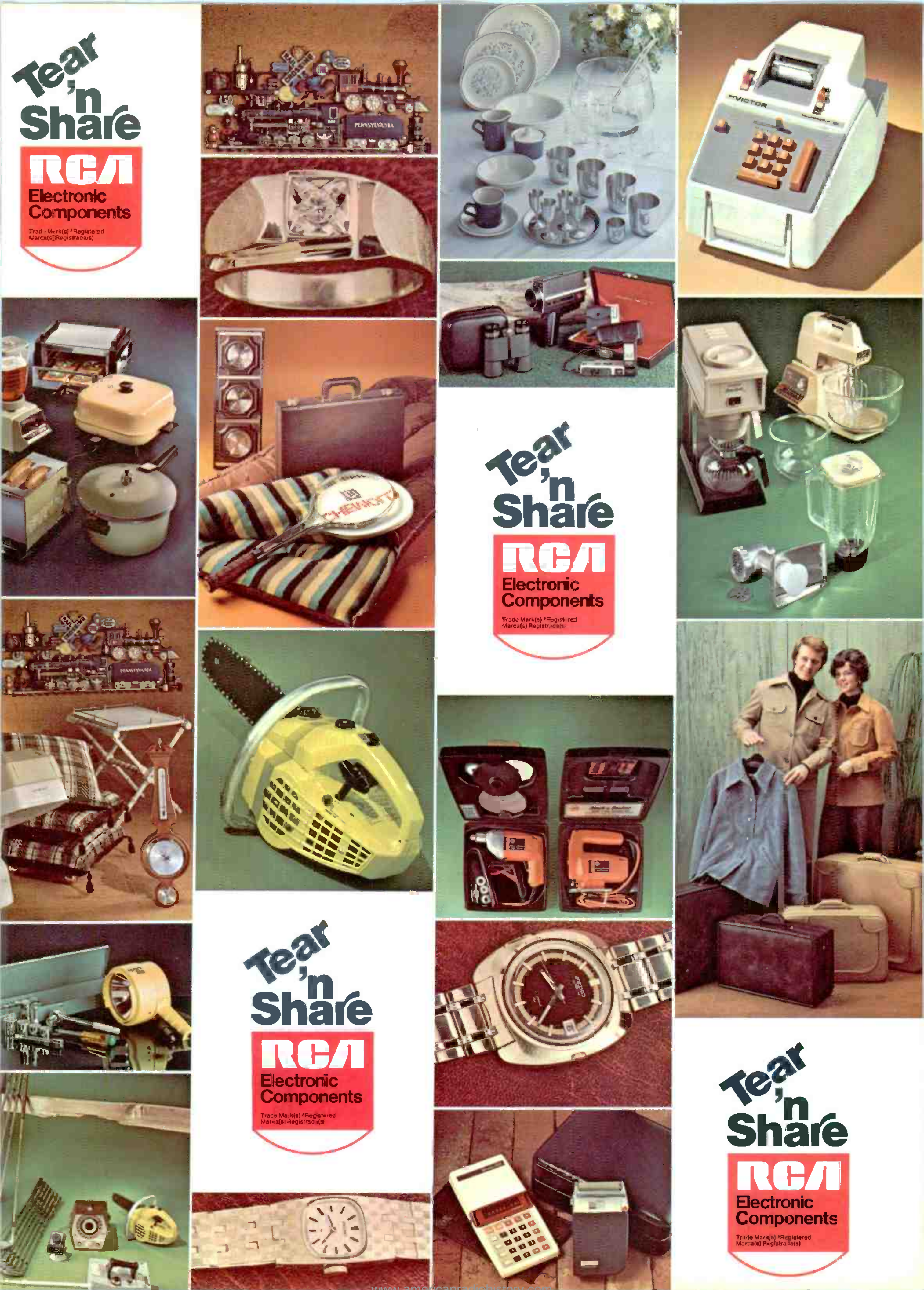
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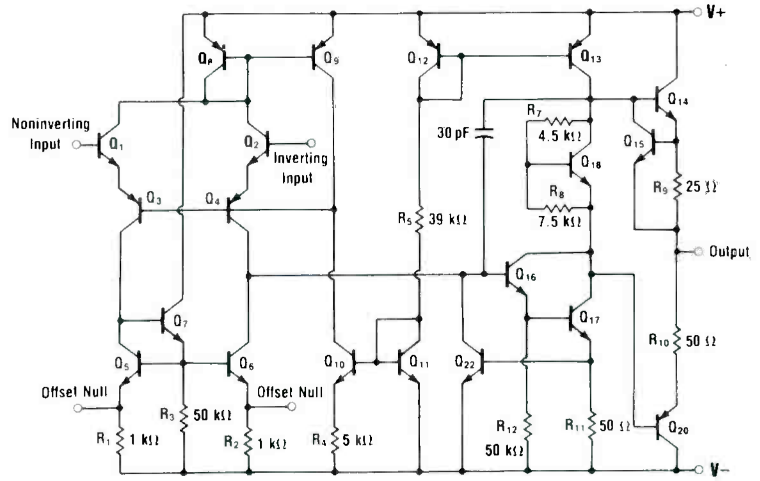


Courtesy Fairchild Semiconductor

The 741 op-amp was the first to have internal frequency compensation that insures stability when the feedback is large. High-frequency roll-off is accomplished by the 30 pF capacitor; therefore, no external terminals are provided for compensation.

neers a wealth of circuit options.

The differential inputs usually have impedances between them of 50K ohms up to several megohms. Also, each input can be used alone to accept an input signal; one can have signal and the other have feedback; or the op-amp can ignore all signals except the ones between the two inputs (differential operation).

The symbol most often used for op-amps is a triangle with the tip pointing toward the right (Figure 1).

Although the physical appearance of IC op-amps often is similar to that of digital-logic components, the internal functions and the waveforms handled are completely different. Digital-logic devices are comparable to switches; they are either on or off. Op-amps, by comparison, are linear devices whose output varies linearly with the input. They perform more like tubes.

Power Supplies

Many schematics show no DC supply source for op-amps. Of course, power is necessary, but often is not listed to avoid cluttering the diagram.

The basic requirement for a zero output voltage (including DC), when there is no input voltage, automatically demands two equal-voltage opposite-polarity power supplies (Figure 2).

It's possible with AC operation where wasted power is not critical

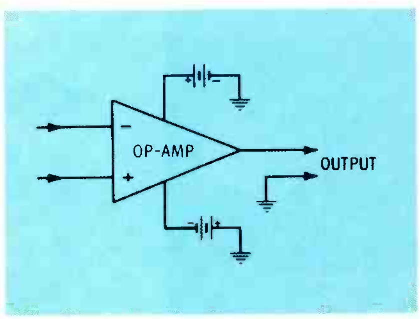


Fig. 2 For those applications where zero output (offset) voltage is required in the absence of input voltage, two identical power supplies of opposite polarity are necessary. AC amplification is possible from a single supply, if input and output coupling capacitors are used.

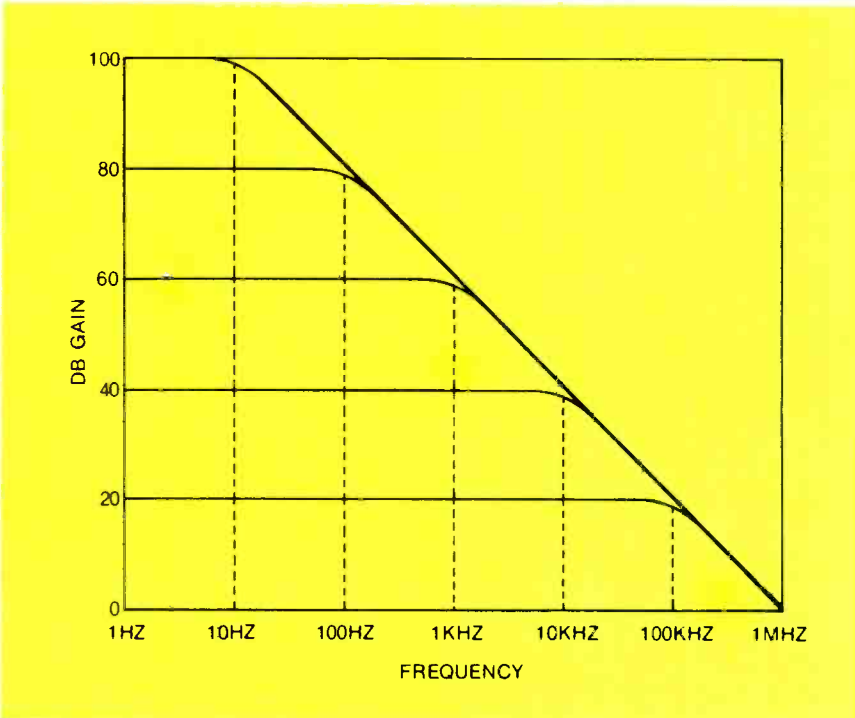


Fig. 3 Frequency compensation to make the gain stable and without self-oscillation severely attenuates the high frequencies. Then external negative feedback is used to flatten the response. The 741 can be made to have flat response up to 1 MHz if the gain is reduced to 1.

to start with a single power supply, split it, and regulate each leg, producing a double supply. Or, if a DC-offset output voltage can be tolerated, the circuit can be changed to accommodate a single supply.

What supply voltages are required for op-amps? The limitation of higher voltages is the maximum-voltage rating of that particular op-amp. At lower supply voltages, the limitation concerns the level of the undistorted output signal. Obviously, the peak output voltage cannot exceed the sum of both power supplies (and it should be less, if low distortion is required). A larger output voltage requires higher-voltage power supplies.

Typical voltages are ± 10 volts DC or ± 20 VDC, although some op-amps are designed to operate at much higher voltages.

Ideally, op-amps should be immune from variations of performance because of power supply fluctuations. In practice, this is not true; therefore, most op-amp supplies are regulated.

Have you noticed that the common ground of the power supplies is not connected to the op-amp? The various stages internally are referenced to the sum of the two power supplies (theoretically, zero volts). Therefore, the output and input connections act as though there were a ground for the power sources.

Negative Feedback

Addition of negative feedback from output to input of the op-amp increases the input impedance between the two input terminals, flattens the frequency response curve, reduces distortion, decreases the output impedance, reduces the gain, and minimizes drift. That seems to be a favorable set of tradeoffs.

As already mentioned, poor high-frequency response is the weak point of op-amps. Not all are as narrow-band as the 741, but most have falling response above a few thousand Hz.

Therefore, for AC operation, negative feedback is used to extend the high-frequency response, and to determine and stabilize the gain. The feedback levels the response by reducing the lows more than the highs (Figure 3). Limitation of the maximum HF correction depends upon how much loss of gain can be tolerated. Best HF response occurs when the gain is unity (1).

Negative feedback requires that the voltage fed back to a previous stage must have a phase of 180° (out-of-phase). With op-amps, this condition is fulfilled by feeding a signal from the output to the inverting input, as shown in Figure 4.

Gain reduction by negative feedback allows great flexibility, because the network can be resistive (for flat response), or the components can have combinations of resistance, inductance and capacitance to produce the desired frequency compensation.

In addition to the advantages of better HF response and stable, accurate gain, other improvements from negative feedback include reduced hum and excellent immunity from overload.

Feedback from the output to the non-inverting input would be **positive** type, giving a snap action similar to that of digital devices. Oscillators might have this configuration. However, such uses are not common for op-amps, so we will not describe them.

Current Or Voltage Theory

The schematic of Figure 5 illustrates one theory of op-amp operation when the non-inverting

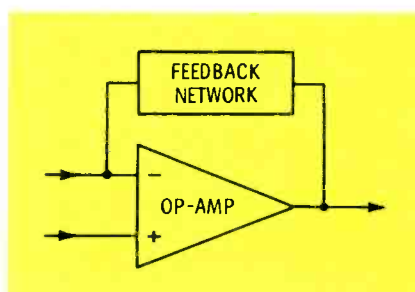


Fig. 4 Phase of the signals at the output and the inverting input are correct for negative feedback; the network is placed between them. The signal input can be either at the inverting input or the non-inverting input, as desired.

input is grounded, and the signal and negative feedback both are applied to the inverting input.

Now, the ones who lean toward current explanations say that a perfect op-amp cannot accept any input current. Therefore, the input current must be cancelled by an equal current obtained from the output. Also, they assert that the inverting input has a very-low impedance. As proof they point to the near-zero DC and AC voltages at that point. Often the inverting input is called a "summing point", although it seems to me it would be more logical to call it a "subtraction point".

Because much of my early electronics work was done with tubes and with audio circuits, I tend to favor the conventional voltage and negative feedback theories.

Negative feedback can be compared to Automatic Gain Control (AGC), but there are important differences. AGC attempts two functions: to correct for variations of internal gain of the amplifiers; and to reduce all signal strengths to the same amplitude. By comparison, negative feedback only corrects for any variations of internal amplifier gain. There is no change of the relationship of strong versus weak input signals.

Let's apply negative-feedback theory to Figure 5. Suppose we supply +1-volts DC from a low-impedance source as input voltage to R1. If the op-amp has an open-loop gain of 50,000 and R2 were open, we would expect an output of 50,000 volts. (Of course, that's ridiculous; the output voltage never can exceed the supply voltage, but follow the reasoning anyway.) However, R2 is not open; it is 100K. According to the ratio of R1 and R2, the op-amp should have a gain of 10. Therefore, the output will be -10 volts. At the inverting input, the addition of +1 volt through 10K, and -10 volts coming in through 100K produces zero voltage! Or so it would seem.

Naturally, an actual zero voltage at that point would represent **no** input, and the op-amp only could give zero output. Obviously, the inverting-input voltage is not true zero, but it is very small. Assuming that an op-amp indeed gives gain according to the ratio of R1 and R2, the voltage at the inverting input is +.0002 volts (or 200 microvolts). That's exactly the voltage required at the inverting input to produce a -10-volt output if R2 were open. Carefully notice this action, for it is typical of both AC and DC negative feedback. The negative feedback cancels part of the input signal, leaving the identical amount required to give that same output if there were no feedback.

In this example, the low input voltage probably could not be measured, even by a digital voltmeter. So, in this case, the inverting input does act as though it is grounded. However, it is important to understand that the "short" is a function of the feedback; the inverting input inside the op-amp is **not** shorted.

To calculate the input impedance at R1, you must proceed as though the inverting input is shorted to ground. In other words, the impedance is approximately equal to the value of R1.

Input Offset Voltage

Any voltage or current at the inputs coming from inside the op-amp affects the output voltage the same as would a signal voltage. If the circuit gave a gain of 100, an input offset of .001 volt would cause an output of .1 volt. This might be objectionable in some circuits.

With a perfect op-amp there should be no DC output voltage when both inputs are grounded. In the real world, such perfect balance seldom occurs. The differential-input transistors are supposed to be identical, and they both are on the same substrate, so their characteristics track fairly well with temperature changes. However, if absolutely no output offset voltage can be tolerated, it's necessary to buck out the input unbalance. This cancellation cannot be effective over large temperature changes, but is good enough for use in heated/air-conditioned buildings.

Many different circuits can be used to buck out offset voltages. One possible remedy is shown in

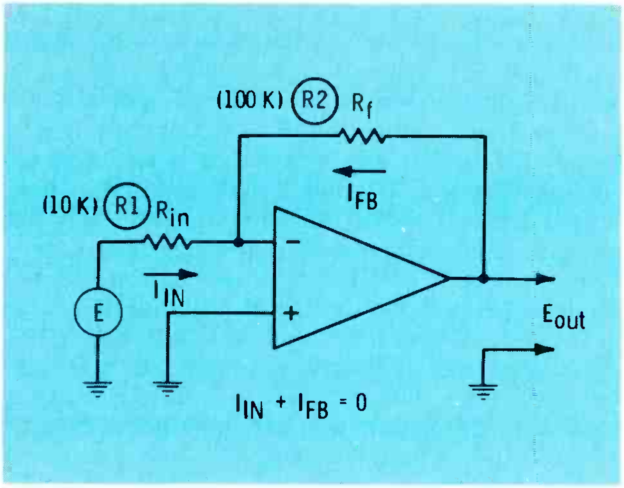


Fig. 5 According to the theory of current, the value of current to the inverting input should equal exactly the current of reverse polarity coming back from the output to the inverting input. Voltage feedback theory states that the value of R1 and R2 determine the percentage of feedback, with the voltages at the inverting input cancelling, except for the tiny amount necessary for proper output voltage.

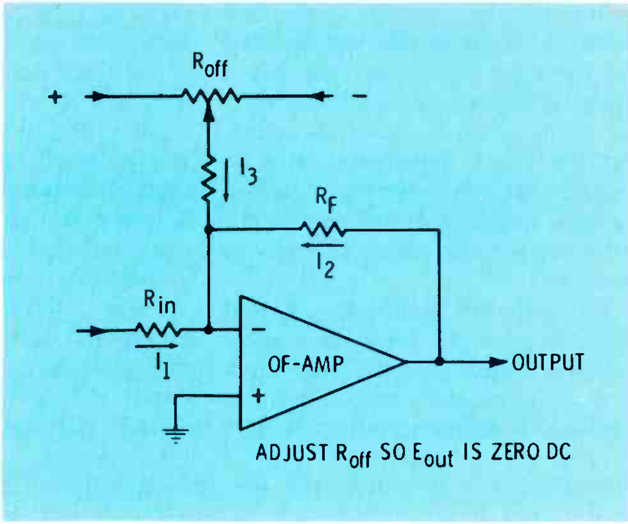


Fig. 6 Any difference of voltage or current between the two inputs affects the output voltage exactly as would an actual input signal. For applications where zero output (offset) voltage is essential, a small adjustable voltage or current is brought in to one of the inputs. There are many ways of accomplishing this nulling.

Figure 6. A small positive or negative voltage is applied to the inverting input, along with the input signal and the feedback. Other circuits apply the correcting voltage to the non-inverting input.

The experts say the input offset can be either voltage or current type. Low-value resistances should be used to correct for voltage offset, and higher-value resistances are advisable for correcting current offset.

Some op-amps, such as the 741, have two terminals for nulling the input offset (Figure 7). This minimizes any possible interference with the normal input wiring.

Frequency Compensation

The frequency compensation necessary to make an op-amp stable with any amount of negative feedback can be obtained in several different ways. As previously stated, the 741 has an internal capacitor to give a severe roll-off of the high frequencies.

Other op-amps have two or more extra terminals for connection of external components. Input compensation, output compensation, or both might be included, depending on the number of the op-amp (Figure 8).

Slew Rate

Simply stated, slew rate expresses the speed with which an amplifier can change its output voltage. The problem is in the inability of an op-amp to drive a capacitive load. This capacitive load can be either internal or external, but most often is internal where no correction can be applied. In fact, the internal capacitance that rolls off the high frequencies (to provide stable operation with large amounts of negative feedback) is perhaps the main cause.

The waveforms of Figure 9 illustrate the slew-rate effect. At high frequencies and high amplifier output levels, the sides of a square wave become sloped. Sine waves might be reproduced as triangles.

The normal roll-off of high frequencies, and the limitations of the slew rate are the two principle restrictions against the use of op-amps where wide bandwidth is essential (for example, in video amplifiers).

Other Circuits

Previous circuits in this article have shown the input and feedback both applied to the non-inverting input.

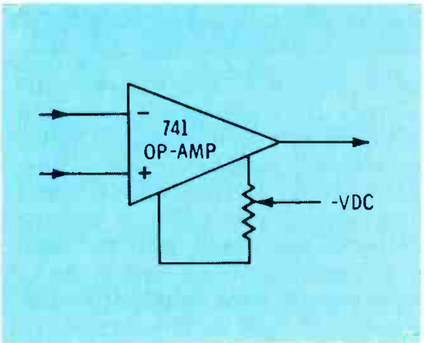


Fig. 7 Some op-amps, such as the 741, provide external terminals for offset nulling.

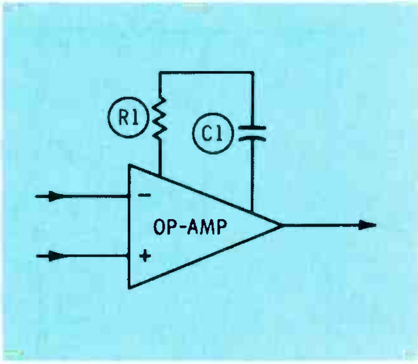


Fig. 8 Not all op-amps have internal frequency compensation. Some have terminals for external compensation. This circuit is for compensation of the input stages; others compensate the output stage, also.

Another basic circuit applies the feedback between the output and the inverting input, but the input signal is applied to the non-inverting input. Gain is about the same, but the input impedance often is higher. Only the polarity of output signal is different. Input and output polarities are the same; there is no inversion.

The extreme condition of that circuit is when the feedback resistor between output and inverting input is reduced to zero ohms. Input at the non-inverting terminal is very high, and the gain is unity (Figure 10).

A circuit that is very effective in ignoring the pickup of hum and noise is the differential-input type. An op-amp responds only to a signal **between** the two inputs. (This is true even when one of the inputs is grounded. There is no permanent ground to an op-amp.)

Figure 11 shows an example of a differential circuit. E3 is the desired signal, while E2 and E1 represent equal voltages of the unwanted signal. The op-amp amplifies E3, but ignores most of E2 and E1.

The ability to reject any signal common to both inputs (relative to ground) is called Common-Mode Rejection Ratio (CMRR), which usually is expressed in decibels.

To achieve the best CMRR, short across E3 and adjust R4 for minimum signal at the output.

Differential operation is extremely useful in scientific and medical applications where the input voltage does not have one side grounded, and the desired signal is weak and buried under hum and noise.

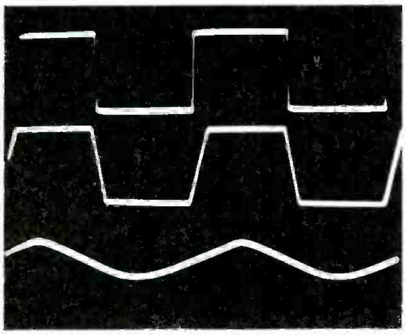


Fig. 9 Slew rate is a problem with op-amps. It is the time required for the output voltage to change. The top scope trace shows acceptable 1575-Hz square waves; 15750-Hz square waves with slew-rate distortion are pictured at the center; and only triangular waves result at 157KHz (bottom trace). These outputs were obtained from an op-amp with good square-wave inputs.

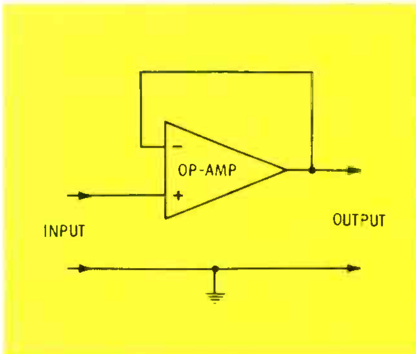


Fig. 10 We might call this schematic an impedance transformer. 100% feedback from output to inverting input, and the input signal fed to the non-inverting input, gives unity gain and flat response to 1 MHz. The input impedance is very high, and the output impedance is very low, perhaps 75 ohms.

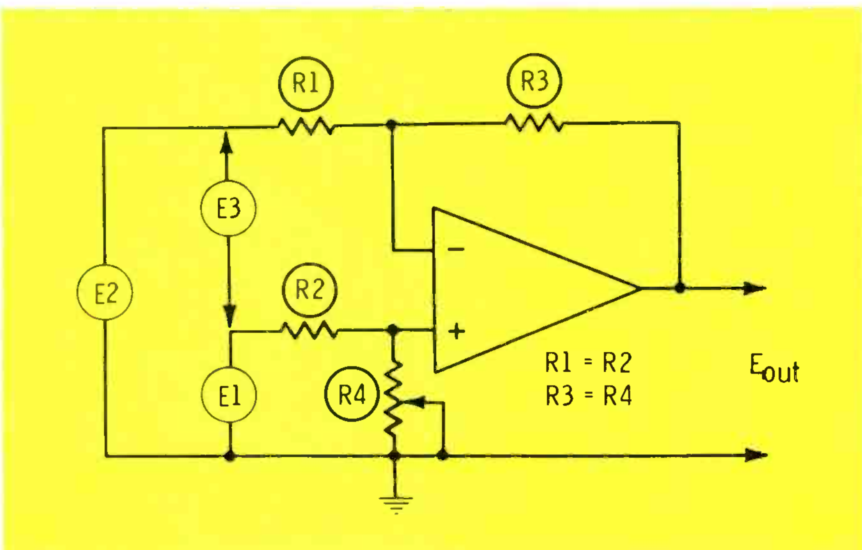


Fig. 11 Differential amplifiers accept any signal appearing between the inputs, and cancel signals that are identical relative to ground. E3 will be amplified, while E2 and E1 will cancel, if they are equal.

Summary

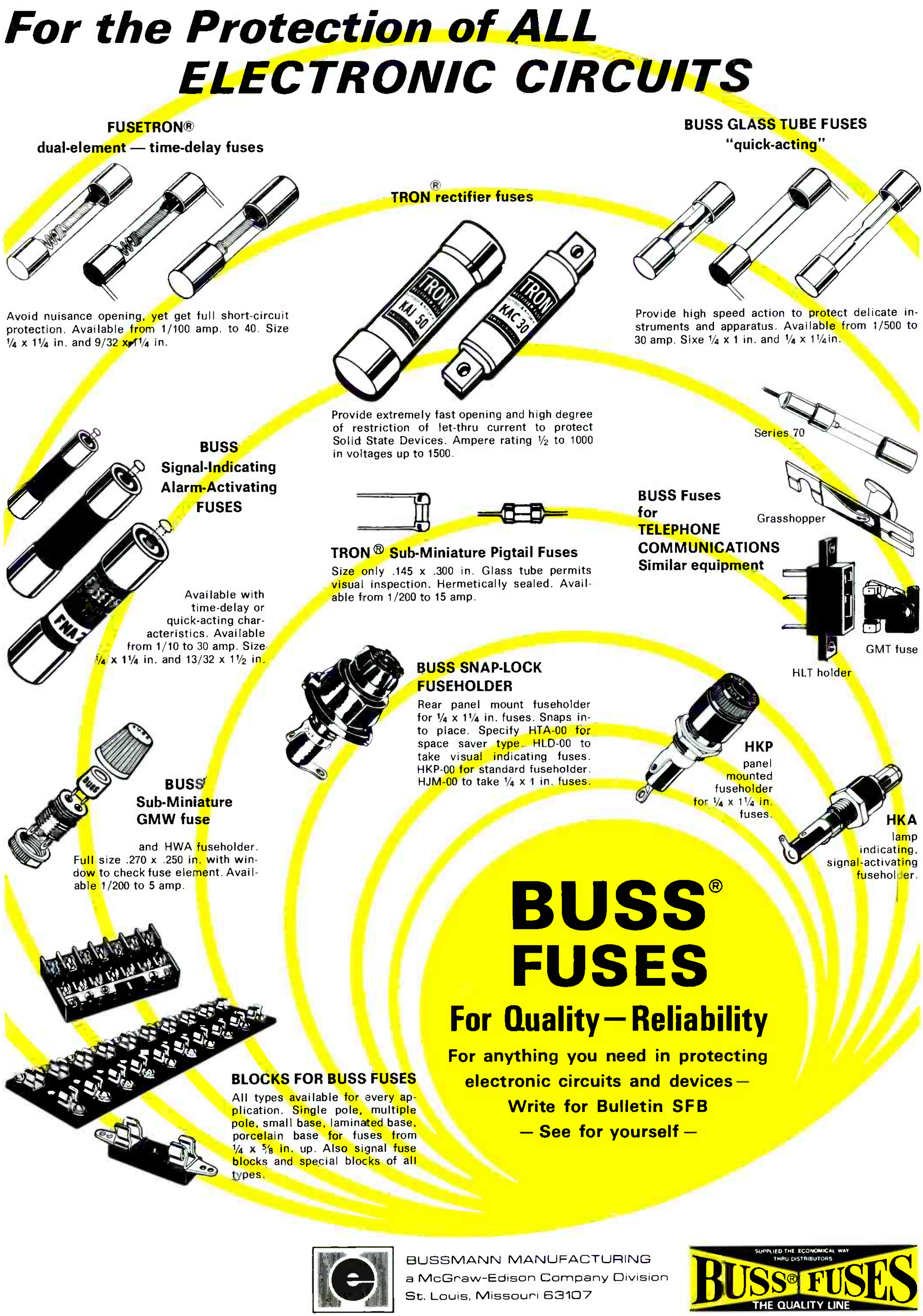
Op-amps have been employed for hundreds of different purposes. Not only can the typical op-amp be used in many ways, but there is a multitude of specialized versions to fit most needs.

Just a few of the many circuits using op-amps are: integrator, differentiator, voltage regulator, notch filter, high-pass or low-pass filter, square-wave generator, oscillator, Schmitt trigger, one-shot multivibrator, staircase generator, sawtooth generator, various logic gates, pulse generator, DC amplifier, audio amplifier, and others too numerous to mention.

If you want to design your own circuits, we recommend you study carefully one of the specialized books about op-amps (such as "IC Op-Amp Cookbook" by Walter Jung, from Howard W. Sams, or "Handbook of Integrated-Circuit Operational Amplifiers" by George Rutkowski, from Prentice Hall.) Watch out for two common errors: make sure there is a proper DC return path for each input; and don't attempt to match the output impedance (that would result in excessive loading and distortion).

When you replace op-amps in commercial equipment, it's best to use the same type. Not only are the terminal connections different in some cases, but not all have internal frequency compensation, the same gain, and other important characteristics.

If you have questions about op-amps or their applications, write to the editor so a follow-up article can be arranged. □



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FM-Stereo Circuits and Adjustments

By Robert L. Goodman

The boom in sales of equipment that includes FM-stereo circuits shows no sign of fading. You can make good money repairing stereo radios; but only if you can make the machines perform as well as (or better than) they did when new, and do so in a minimum of time. Here is information about the multiplex signals, and some of the adjustments to improve the separation of channels.

An FM-stereo receiver appears to be a conventional FM radio, with only a special multiplex section and dual audio amplifiers added to the usual tuner, IF's and discriminator circuits. This impression is not quite true, for proper operation of the multiplex involves phasing, and that demands wider bandwidth, less distortion, and flatter phase response of the IF's and discriminator stages than is necessary for plain FM radio.

Of course, sometimes this superior performance can be obtained by correct, careful alignment and adjustment of the IF and multiplex circuits. We will include tips to help with this goal.

Technicians always can adjust and repair circuits more efficiently when they understand how the circuits work and why the adjustments are necessary. With this in mind, let's review briefly the fundamentals of FM-stereo operation.

Matrixing Two Audio Signals

Stereo **could** be broadcast over two identical transmitters, one handling the right-channel audio, and the other modulated by the left-channel sound. In fact, some pioneering broadcasting was done with an AM station and an FM station, each transmitting one stereo channel. Of course, such operation is not practical.

The system finally approved can be broadcast from one FM station, and it has the advantage of being "compatible". That is, the program is heard in normal monaural from ordinary FM receivers, and is heard in full stereo when the receiver has a multiplex unit and double amplifiers.

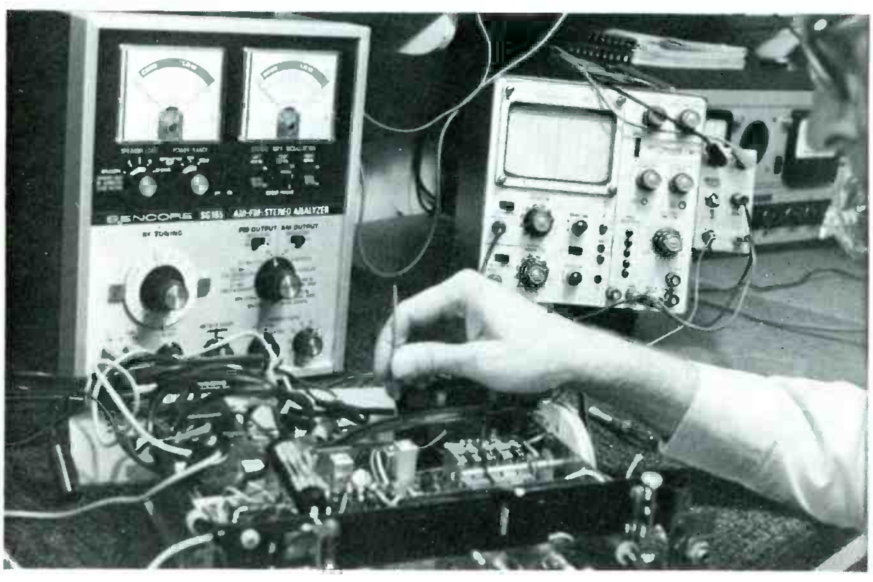
Because of the compatibility requirement, it's not possible to keep the right and the left audio signals as the two signals. Instead, they are combined, or mixed, in a special way, and must be decoded in reverse at the receiver.

The main program signal (the one heard on monaural receivers) is a simple mixture of the two stereo channels. That is, Left plus Right (L+R). The secondary combined signal is Left minus Right (L-R), and it must have special treatment. This L-R signal amplitude modulates a 38-KHz carrier, creating sidebands. Then the carrier is eliminated (to minimize distortion, overload, and crosstalk), leaving the sidebands.

That gives the two signals from which the original left and right signals can be derived at the receiver. One essential still is missing: there's no way of demodulating the 38-KHz sidebands to recover the L-R signal. A strong continuous carrier of identical frequency and phase as the original 38-KHz modulated carrier must be generated in the receiver. There is no dead time for inclusion of a 38-KHz burst (as is done with the burst in color-TV work), so another plan is used.

A 19-KHz pilot carrier, phase locked to the original 38-KHz oscillator, is supplied. It is between the two frequency ranges used, and it can be doubled in the receiver to produce the 38-KHz carrier required there.

Therefore, modulation of the station's carrier is accomplished by the sum of three signals (Figure 1): the L+R signal, a 10% pilot carrier of 19 KHz, and the 38-KHz sidebands carrying the L-R signal.



Bob Goodman tweaks an adjustment in the multiplex circuit of an AM/FM-stereo radio receiver.

Separating The Signals

Those three signals also are found at the output of the discriminator in the receiver. They must be changed (by decoding) into pure Left and Right audio signals.

Originally, receiver multiplex circuits were quite complicated. For example, a bandpass circuit tuned to accept 23-KHz to 53-KHz frequencies was necessary to separate

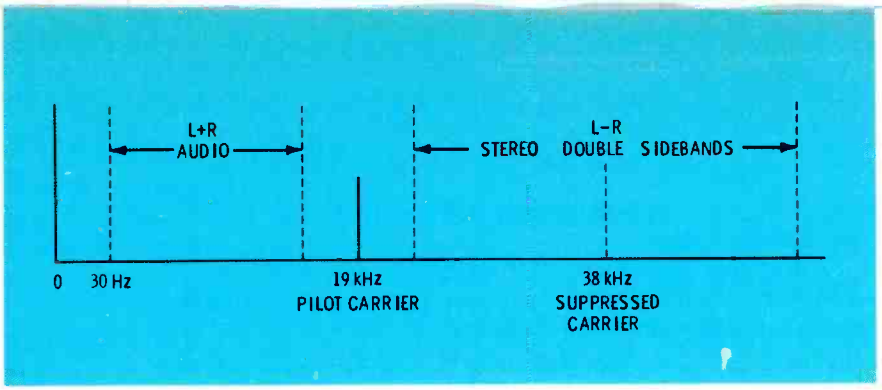


Fig. 1 The composite audio signal that modulates the FM carrier is made up of these elements. (Of course, the same signal is found at the output of the discriminator stage in the receiver.) The main audio signal is the sum of the right- and left-channel stereo audio, so that monaural receivers can reproduce all of the music. A second signal is composed of left minus the right audio, and it amplitude modulates a 38-KHz carrier in a circuit that suppresses the carrier, leaving only the sidebands. A 19-KHz pilot carrier of 10% amplitude is included; in the receiver it can be doubled to 38-KHz and used to demodulate the L-R signal. That frequency is above the range of human hearing, and easily can be filtered out when not wanted. Some stations broadcast background music or storecasting programs over a 67-KHz carrier; this is called Subsidiary Carrier Authority (SCA). Most receivers have traps to remove this frequency to prevent distortion or whistles in the stereo program material.

the 38-KHz sidebands from the composite audio. The 19-KHz pilot carrier often was used to synchronize a 38-KHz oscillator, and the 38-KHz carrier was combined with the L-R sidebands before this reconstituted carrier was demodulated by an ordinary AM diode detector. Output of the detector was the original L-R waveform. Now, both of the sum and difference (L+R and L-R) signals were available, but they required further treatment to produce separate left and right stereo signals. When the two were added together, the right signals cancelled, leaving the left. When they were subtracted (one through a phase inverter), the left signals cancelled, leaving the right.

Modern Multiplexing

After all the extensive circuitry of the older multiplex units, it's a relief to examine a typical modern circuit (Figure 2). There is no bandpass tuned stage, and no complex mixing of the signals is necessary.

Diode-bridge demodulator

Perhaps the most popular of present-day multiplex demodulators is a bridge with 4 diodes, plus a parallel injection of the composite audio (which includes the L+R audio signal and the sidebands of the 38-KHz L-R signal). A simplified schematic is shown in Figure 3.

If the audio signal connected to the centertap of the transformer contained no L+R audio, but only 38-KHz sidebands, the two outputs would be L-R and -(L-R). These could be added to the L+R to give 2L and 2R signals.

But the audio at the centertap **does** contain the L+R signal, and so the addition is done without a separate circuit.

Assume that the "B" end of the winding has the positive peak of the 38-KHz sine wave. Diodes D1 and D3 conduct, bringing the demodulated L-R signal to the left-audio output. Also, conduction of D1 brings the L+R from the center tap to the left-audio output. Addition of the two gives a double portion of L, but no R, for the -R and +R cancel.

When the "C" end of the winding is positive, diodes D4 and D2 conduct, demodulating -(L-R) and conducting L+R. This time the addition produces double R, but no L at the right-audio output.

Several comments need to be made here. Notice that the polarity of the diodes is not the same as the arrangement of a power-supply diode bridge. Also, this is a **synchronous** demodulator, whose action is very similar to that of a color-TV demodulator. In other words, the **phase** of the 38-KHz carrier is very important for best results. Minor phase errors affect the amount of crosstalk (left channel leaking into the right, and vice versa).

Ordinarily, audio signals passing through diodes suffer considerable distortion because of the nonlinear-

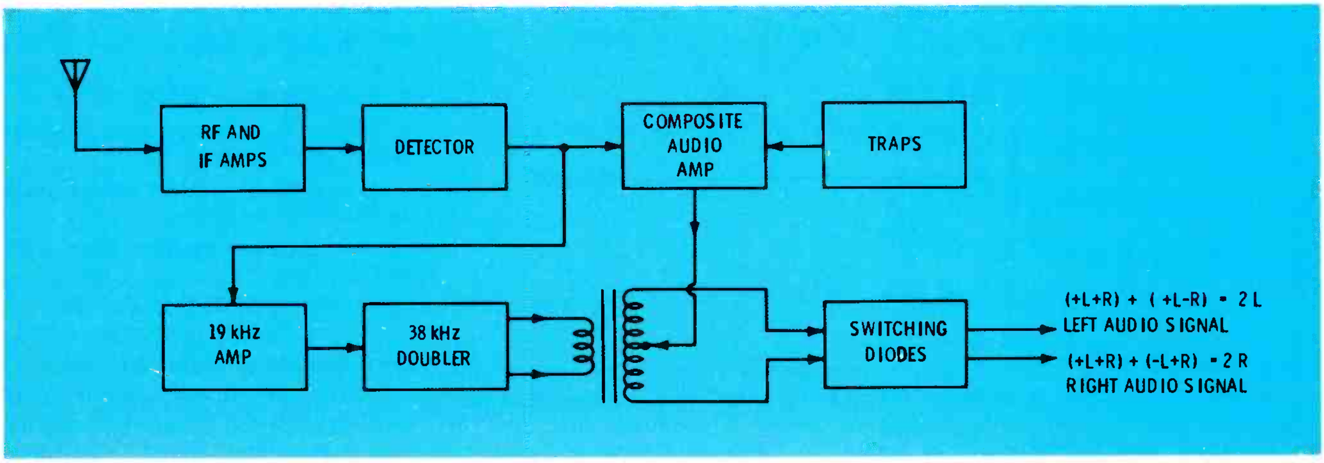


Fig. 2 Without the bandpass tuned amplifiers of the older multiplex circuits, the block diagram of a modern FM-stereo radio is not complicated.

ity according to polarity of the signal. Why is the distortion here almost zero? In this circuit, the diodes approach the function of switches; they either pass the signal or they don't, so the signal that does pass through is not distorted.

Because of the keying action, the audio from the bridge is chopped into 38-KHz square waves. That's why a low-pass filter must be used, following the demodulation, to remove the extra waveforms from the audio.

A Typical Multiplex

Figure 4 shows the schematic of a Zenith multiplex channel. Q301 amplifies the composite audio signal coming from the discriminator stage. The transformer in the collector circuit (T301) is tuned to 19 KHz by C304, and it also couples the signal to the base of Q302.

In addition, the tuned primary functions as a 19-KHz trap to remove the pilot carrier from the composite audio that is taken from the tap of the primary winding.

Q302 amplifies the 19-KHz carrier. It appears to be a normal amplifier stage, but there is one peculiarity. The gain is varied in **reverse** from the way an AGC-controlled stage would be. When the amplitude of the 19-KHz signal is low, the gain is small; a strong signal triggers extra gain. This will be explained later.

T302 is labelled "19-KHz doubler", but the transformer doesn't double anything. However, the center-tapped secondary winding supplies signal to two diodes wired as a full-wave rectifier (non-peak-reading type).

Input to the transformer (T302) is a 19-KHz sine wave (see Figure 5), at the cathodes of CR301 and CR302 the waveform has 38-KHz parabolas, and after the parabolic waves are amplified by Q303 and tuned by T303 and C310, the output to the demodulator is 38-KHz sine waves. This carrier is reinserted into the sidebands to replace the one removed at the station.

Demodulation

Instead of a diode bridge, this machine uses a symmetrical FET (Q305) as a demodulator. Strong composite audio is fed to the gate, while weaker audio connects to the centertap of the secondary of T303. Although the exact theory of operation is a little obscure, the demodulation and mixing produce left and right audio signals.

Stereo light

Positive voltage from CR301 and CR302 is filtered and applied to the base of Q304. This is forward bias, and when it is sufficient, collector current flows, lighting the stereo lamp to indicate that the program is broadcast in stereo.

Stereo squelch

FM-stereo reception is more susceptible to noise interfering with weak signals. Therefore, many receivers switch to monaural when the signal is too weak. When no pilot carrier is being received, Q302 has insufficient forward bias, producing very little gain. But when the 19-KHz pilot carrier begins, positive voltage from CR301 and CR302 raises the forward bias, which increases the gain. More gain results in more positive output from the diodes, and even more gain. The action is regenerative, and finally reaches a point of equilibrium where the transistor gain is maximum. A fixed emitter voltage (although adjustable to set the point where gain begins) is supplied by R306, R307, and R308.

Weak or monaural signals prevent formation of the 38-KHz carrier; and without it the circuit automatically becomes monaural, to eliminate noise.

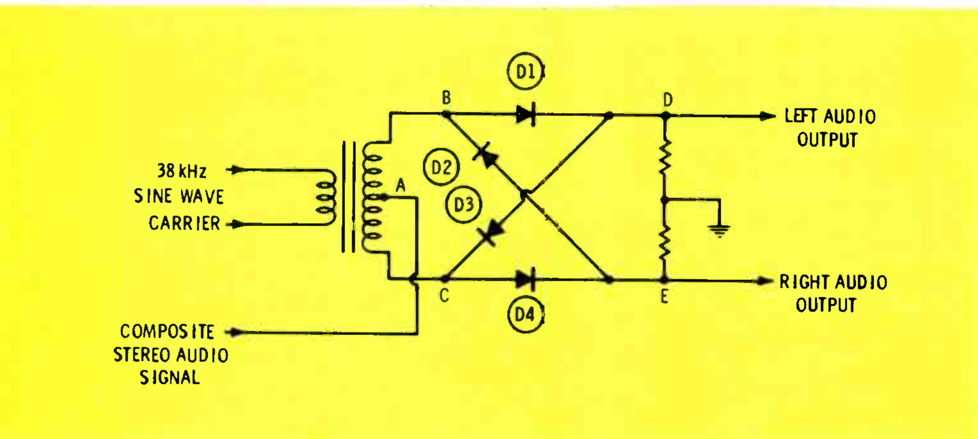


Fig. 3 Diode-type synchronous demodulators greatly simplify the new circuits by not requiring separation of the L + R and L-R signals. Two basic actions take place here: the correctly-phased 38-KHz carrier is inserted into the L-R sidebands to form the original L-R signal, by diode demodulation; also the L + R audio (a part of the composite audio) combines with the L-R audio to provide true left and right stereo audio signals.

Testing Separation

The conditions necessary for good channel separation (minimum crosstalk between left and right audio signals) are critical. All circuits and adjustments must be right on the nose, if the best separation is to be obtained. That's why we should not try to rely only on audible ear tests to evaluate separation. A good-quality stereo generator should be used.

Using the Sencore SG165

Testing for channel separation by using the Sencore SG165 Stereo Analyzer takes far less time than is required to read about it.

Locate a clear spot on the dial of the receiver, connect the output cable of the SG165 to the antenna terminals, switch to the FM-modulated signal and tune the generator for about the same frequency as the receiver. Carefully tune the receiver to the generator signal (use tuning indicator, if available), disconnect the speakers, connect the meter

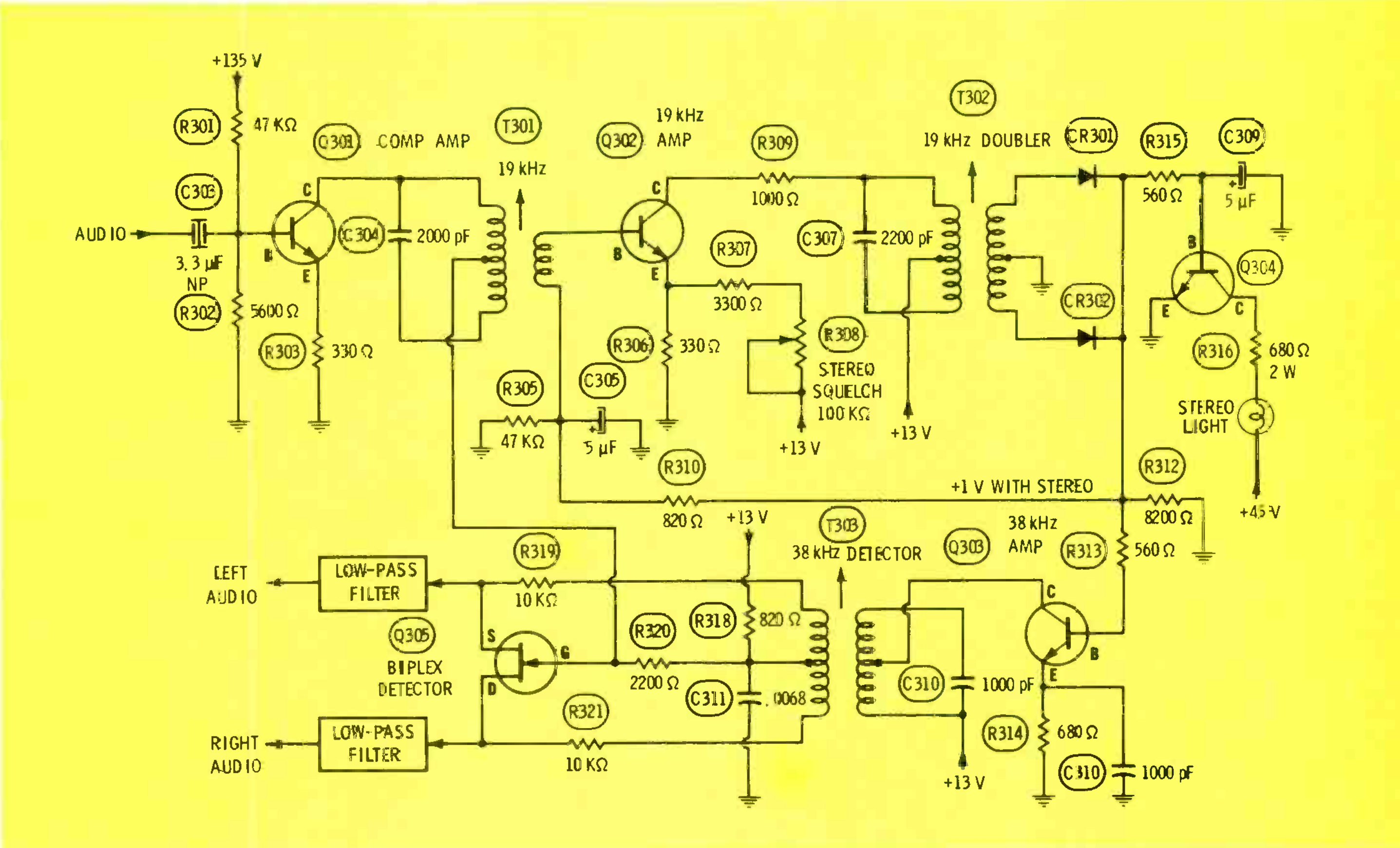


Fig. 4 This Zenith circuit uses an FET as a synchronous demodulator, instead of 4 diodes. Automatic switching from monaural to stereo is done by changing the bias of Q302. Without a signal, there is no 19-KHz pilot carrier, and therefore no positive DC from CR301 and CR302. Q302 has too little bias to give full gain. When a stereo program is received, the 19-KHz signal causes CR301 and CR302 to put out positive-going parabolic waveforms. This signal is used in three ways: partly to bias Q304, the light amplifier; some to provide 38-KHz signal to Q303; and the rest to increase the forward bias of Q302, giving increased gain.

leads of the SG165 to the amplifier outputs, set the SPEAKER LOAD switch for the approximate speaker impedance, and increase the volume of the receiver to give a high meter reading (use scope to be sure the signal is not clipped). Use the balance control to make the meters read the same.

Check for channel separation by turning off the left 400-Hz stereo modulation. The difference in the meter readings gives the separation in decibels. Turn on the left 400-Hz modulation, and turn off the right 400-Hz modulation. Read the separation again. The two separation readings should be nearly the same; but usually there is a difference. If the difference is large (say 6 dB or more), the adjustments should be touched up, or even compromised a bit, to make the crosstalk about the same between right and left channels.

Touch-up Adjustments

The IF's can be aligned (or tested for alignment) in several different ways, including 10.7-MHz sweep with markers, but we will assume the rough alignment has been done. Surprisingly, major improvements of channel separation usually can be achieved in a touch-up of the IF and multiplex adjustments.

IF symmetry

With the equipment connected as given before for the separation check, turn off the pilot carrier, turn on the 400-Hz modulation for one channel only, and connect the scope to the FM-detector test point. If the machine has no test point there, find the output of the discriminator before de-emphasis or

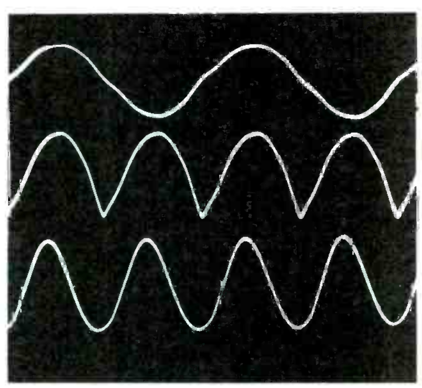


Fig. 5 The top trace shows the 19-KHz sine-wave signal from Q302. 38-KHz parabolas are formed by rectification at the common cathodes of the diodes (center trace), and after amplification and filtering, the parabolas become 38-KHz sine waves (trace at bottom) ready to demodulate the sidebands.

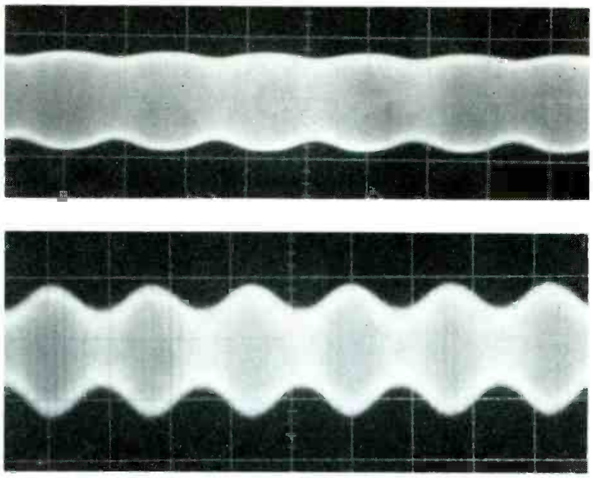


Fig. 6 When the FM signal generator has 400-Hz modulation, nonsymmetrical top and bottom sine-waves (picture at the top) of the signal from the discriminator indicate poor IF alignment which reduces separation of the two stereo channels. Correct waveform for minimum crosstalk is shown by the bottom picture.

before the audio goes to the multiplex unit.

The waveform should be similar to one of the two examples of Figure 6 (an audio-modulated carrier). If the sine waves of the audio are not identical on top and bottom of the carrier, the IF adjustments should be changed slightly to make them identical.

Tweaking the multiplex

Further improvement of separation often can be obtained by minor adjustments of the 19-KHz and 38-KHz transformers in the multiplex circuit.

For this step, the equipment is connected as before, with the FM modulated RF generator signal tuned to an unused spot of the dial. Modulate both channels and turn on the pilot carrier set to 10%. Change the scope to external horizontal (or use the X/Y setup of a dual-trace scope), and adjust the vertical and horizontal amplifiers of the scope for equal gain. Connect one to the right-channel speaker output and the other to the left-channel output.

The scope waveform now should be a diagonal line at a 45° angle (Figure 7). To check the separation between channels, switch off the modulation of one channel. The scope should show a vertical or a horizontal line, depending on which speakers leads are connected to which scope inputs. Reverse the modulation to the two channels, and notice the straightness of the lines.

Straight vertical and horizontal lines, during this test, indicate good separation between channels. However, if a line has a bend as shown in the bottom waveform of Figure 7, the separation is poor. Also, the lines should be perfectly vertical and horizontal for minimum crosstalk.

A touchup of IF alignment, and slight re-phasing of the 19-KHz and 38-KHz coils in the multiplex section, are recommended whenever the tests show insufficient separation.

Adjusting Stereo Squelch

Many FM-stereo radio receivers have a circuit that automatically switches to monaural when the 19-KHz pilor carrier is missing, or when it is too weak. The control might be called any one of many different names, such as squelch or threshold.

Regardless of the circuit or the title, adjustment is simple. Reduce the level of the 19-KHz pilot to 5% at the generator, and adjust the squelch control so it switches to monaural (according to lamp, or stereo effect you hear through the speakers), then reverse the rotation until the circuit **barely** switches to stereo. That's all.

Troubleshooting Methods

A scope is strongly recommended for locating the stage where a signal defect occurs. This can be done either with a generator or with normal station signal input to the antenna terminals. Of course, improved accuracy can be obtained by using a stereo generator.

If the complaint is insufficient separation (too much crosstalk), then a stereo generator is mandatory.

After the malfunctioning stage has been located, DC voltage and ohmmeter tests are best.

Although testing of individual transistors and a visual search for bad solder or cracked boards will uncover many troubles, it's still true that uniform success with **all** FM-stereo problems demands equal amounts of knowledge and test equipment. □

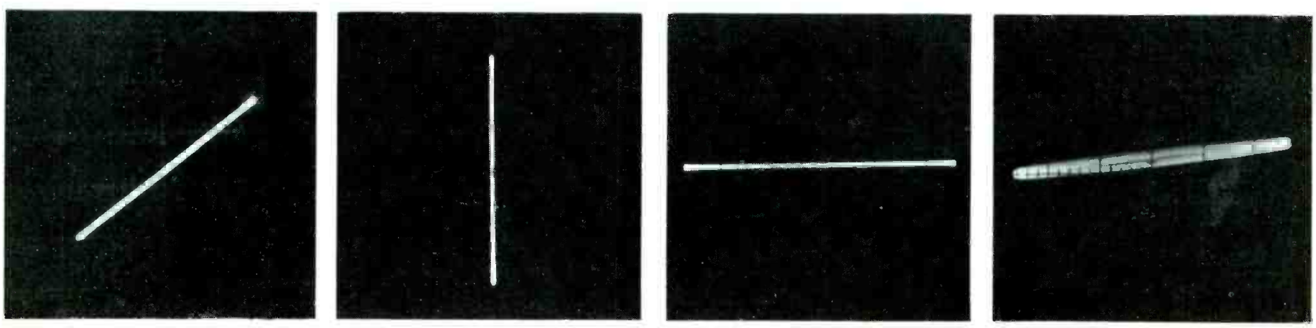


Fig. 7 Vector display of the left and right stereo audio output, when the generator modulation is switched, can indicate the amount of channel separation. When both channels are modulated, the result is a 45° line (picture at the left). The next two pictures show either a vertical or a horizontal line depending on which channel has the modulation. At the right, poor alignment has caused insufficient separation, as proved by the slight tilt and double trace of the horizontal line.

Servicing Modular Color

Part 5/By Charles D. Simmons

Circuits and adjustments of the 9-86 chroma module conclude our coverage of the Zenith 19EC45 portable color-TV series. IC's have replaced transistors, and the switches and controls make the field adjustments easy to do.

Regardless of the model or manufacturer, **the basic functions of all chroma circuits are the same.** Chrominance sidebands must be removed from the composite video, amplified, and tuned to give the correct bandwidth and phase. Burst is extracted from the chroma, and used to create or control a continuous 3.58-MHz carrier. Samples of the 3.58-MHz carrier, having the proper amplitudes and phases, are fed to the demodulators, along with the chrominance sidebands. Outputs from the two or three demodulators are R-Y, B-Y and G-Y signals, which are matrixed with the Y (video) signal and used to control the instantaneous brightness of the three color guns.

Secondary functions include control of color saturation and tint, color-killer action, Automatic Chroma (gain) Control (ACC), and sometimes Automatic Tint Correction (ATC).

Zenith IC Chroma

In other words, the block diagram of the chroma circuit in Zenith 19EC45 color portables would be nearly identical to that in other models of color receivers.

And that's good, because it helps offset one disadvantage of troubleshooting IC circuits instead of those with tubes and transistors. Now, IC's operate just fine, but they obscure the way we can merely look at a tube or transistor circuit and trace the path of the signal by the kinds of components around them. If this disadvantage of IC's were to be further compounded by unfamiliar functions, then servicing these chroma circuits would be difficult indeed. As it is, we need only take a few extra minutes to find the best testpoints for waveforms and voltage measurements, and our tried-and-true servicing methods can guide us to the defect.

It is true that we must use more care in making our tests. Turn off the power before connecting a meter or scope probe, use an insulated clip or hook for solid connection without danger of intermittent shorts, turn on the power long enough to take the reading, then turn it off while you remove the clip. If the pin of the IC cannot be grasped solidly, without the possibility of an accidental short, locate a discrete component that is wired to that same pin, and connect to it for the test. Remember that a split second overload of an IC can ruin it.

Service data is necessary

Unless your servicing is confined to blind replacement of entire modules, then complete and accurate service data is essential. **You must know the test points, and the kind of signals** (plus their amplitudes and waveforms) **at each one.** Many of the major components and test points of chroma module 9-86 are shown in Figure 1.

IC1001

With a good schematic, such as the one from Photofact in Figure 2, plus the module layout, we can trace the paths of most signals.

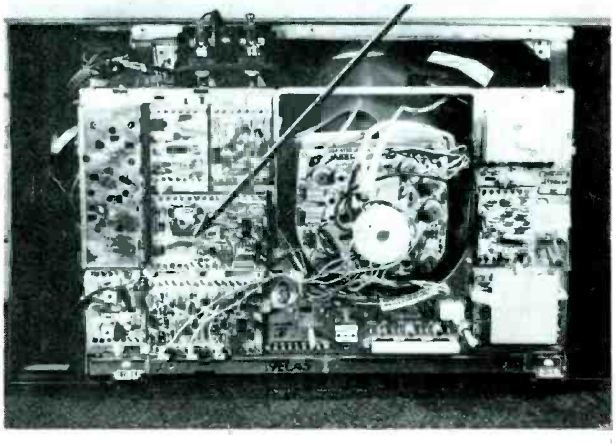
For example, composite video enters the module at U12, the chroma is extracted by L1002 and C1006 (the CROSS TALK control varies the tuning effect of C1006), it passes through C1008 and finally reaches pin #2 of IC1001 (Figure 3). Incidentally, IC1001 functions as chroma bandpass amplifier, killer, and demodulators.

Although the "black box with gain" does not allow as many test points as those possible with discrete components, there are several important ones. An intermediate point is pin #3 (also module U14) where the chroma signal appears on the way to supply burst to IC1002 (Figure 4).

Just prior to demodulation, the chroma comes out to L1001 at pins #13 and #14 where it can be checked with a scope. Probe loading is less severe at pin #13, so it is recommended as the observation point.

Notice that the color control has

9-86 CHROMA MODULE



The arrow points to the 9-86 chroma module on the 19EC45 Zenith Chassis.

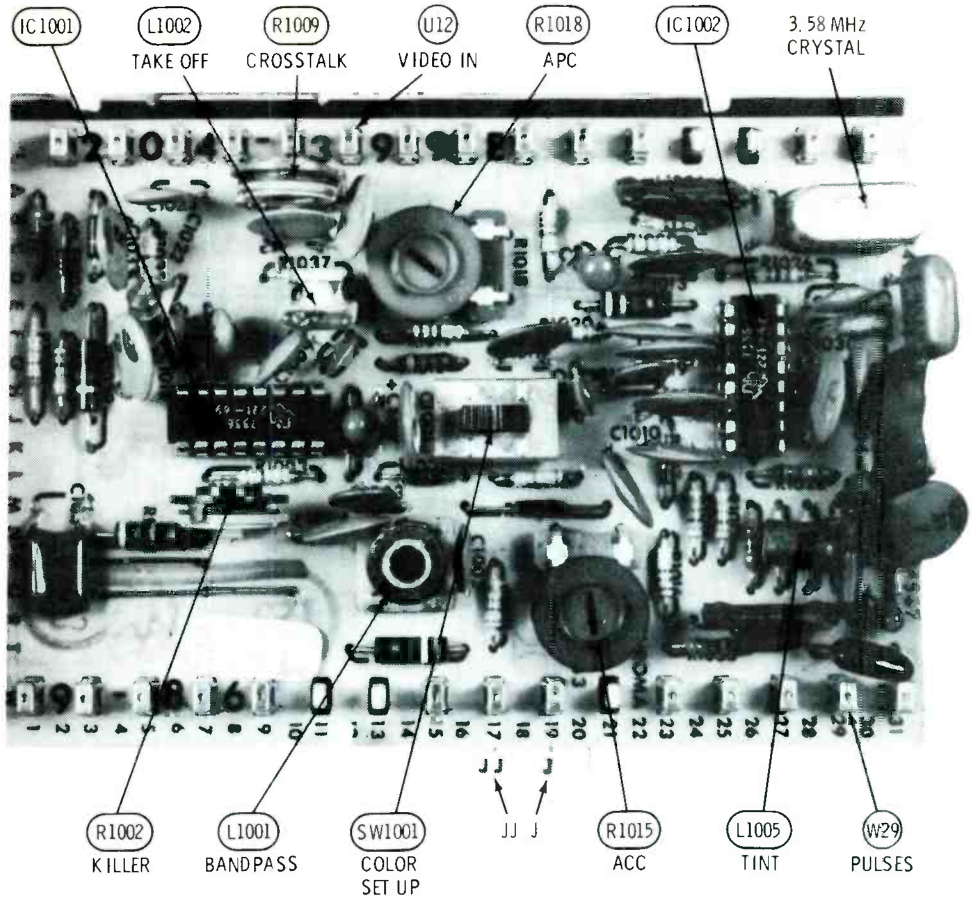


Fig. 1 Locations of major components and adjustments on the Zenith 9-86 chroma module are shown.

no chroma signal fed to it. The control merely varies a DC voltage at module terminal U4.

Figure 5 shows the -Y demodulator signals appearing at module terminals W5, W3, and W7.

IC1002

IC1002 functions as the 3.58-MHz oscillator, burst amplifier, color locking (APC) and ACC.

At this point, Zenith rates an award for being kind to technicians. Other sets require you to kill the burst, usually by grounding a certain point with a test lead, before you can set the frequency of the color oscillator. That's more difficult with the small, crowded terminals of IC's, and there's a risk of slipping or connecting to the wrong terminals and burning out the IC. Not with these Zenith's. A color-setup "NORMAL/ALIGN" switch easily removes the burst for you. In addition, it establishes the conditions so the proper ACC level can be adjusted, by using a meter to determine the correct setting.

The tint control does not directly change the phase of the 3.58-MHz carrier. There is no AC signal at the tint control; it operates by varying a DC voltage at module terminal W23.

Although a scope waveform of the 3.58-MHz carrier could be obtained at pin 7 of IC1002, it's faster just to go to module terminals W25 and W27 and check for the B-Y and R-Y carriers. If they are of normal amplitude (Figure 6), it's certain the oscillator is operating.

Chromatic Switches

When the Chromatic switch is "on", it connects preset controls for tint, color, brightness, and contrast. The factory setting of these controls can be changed by removing a trim strip on the front panel.

Also, one more circuit of Figure 2 should be explained. That's the one marked ATG. When the Chromatic is "off", the phase of the carrier for the B-Y demodulator is determined by L1003, R1025 and C1022. At that time the additional phase delay from C1023 is not in effect, because diode CR1022, which is between C1023 and an AC ground through C1033, is reversed biased, acting as an open circuit. About +8 volts is applied to the anode of CR1022 by R1035 and R1033, while the cathode has about +23 volts. Module terminal U2 is grounded when the Chromatic is "on", and this connects the cathode of CR1022 to ground through R1034, a 1K resistor. CR1022 now has strong forward bias, making it a virtual short circuit, and grounding C1023. This connects C1023 in parallel with C1022, and increases the phase angle between the carriers applied to the two demodulators. The effect is to widen the range of orange hues in the color picture, and make the tint setting less critical.

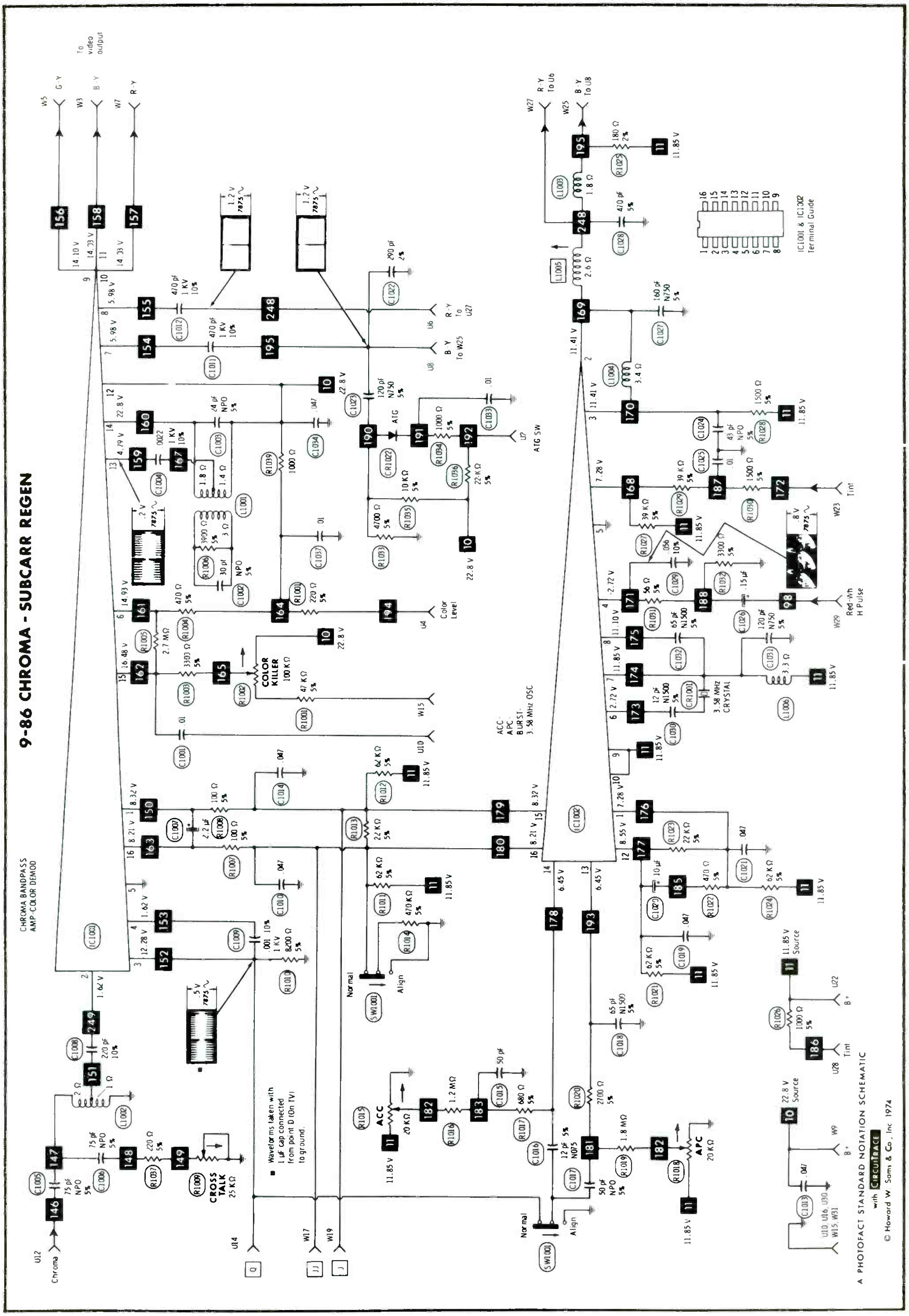
Locking The Color

Color locking, and chroma adjustments other than bandpass alignment, easily can be done in a few moments. Use this sequence:

- Tune in a color bar pattern, with Chromatic switch off, and adjust the fine tuning for best sharpness of the bars without beat pattern (if generator has no sound carrier, use the AFT);

- Temporarily connect a 1 microfarad capacitor from the center lug of the contrast control to ground to

9-86 CHROMA - SUBCARR REGEN



remove the video; adjust the CROSSTALK control for even coloring across each color bar with best sharpness of the edges; remove the jumper and capacitor; keep the color bars;

• Slide the color setup switch (SW1001) to the ALIGN position; connect a VTVM from point "Q" (U14) to ground. Short between terminals "J" and "JJ", and notice meter reading. Remove the short, and adjust the ACC control (R1015) for the same meter reading obtained previously;
• With setup switch still in ALIGN position, rotate the APC control (R1018) until the color bars float sideways (zero beat); restore setup switch to the NORMAL position; and the bars should be locked solidly.

If the color bars zero beat properly, but the locking is not perfect in the NORMAL position of the setup switch, you should suspect loss of burst. Use a scope to check for the keying horizontal pulses first at module terminal W29, and then at IC1002 terminal 4 (Figure 7). Without keying pulses of the correct amplitude, there cannot be sufficient burst.

If skin color can be obtained only with the tint control at either end of its rotation, adjust L1005 so normal hues are obtained nearer the center of the tint control. For better accuracy, use color bars, attach the lo-cap scope probe to test point "R" (red cathode of the picture tube), and adjust L1005 for the 6th bar at crossover.

CRT Waveforms

Matrixing of chroma and video signals produces three color signals which are applied to the three cathodes of the picture tube. The three grids are tied together and have only a DC voltage; there are no AC waveforms or signals at the grids.

If you have not checked similar waveforms before, these cathode signals will seem to be all wrong. The brighter color bars are negative-going; for a negative-going cathode signal gives the same effect as a grid signal that is positive-going. Wide, positive-going horizontal-blanking pulses are there, along with strong vertical-blanking pulses. These are shown in Figure 8.

Factory instructions say to eliminate the video component by connecting a 1 microfarad electrolytic capacitor from point "D" of the 9-89 video-output module to ground. Of course, that kills the video and with it the blanking pulses. In addition, it seems to change the operating voltage of the video transistors and distorts the bar waveforms (Figure 9). I don't believe it is necessary or desirable to eliminate the video. Just run the contrast at minimum, and the remaining video will not interfere with the color bars.

Of course, if your color bar pattern has **dark** spaces between the color bars, you can eliminate the video portion of the matrixed waveforms by bypassing the center terminal of the contrast control to ground through a 1 microfarad capacitor.

Sound Circuits

Another area without transistors is the 9-103 audio module (Figure 10). Two IC's do it all. IC1101 incorporates the sound IF amplification, audio detection, and the low-level audio amplifiers. IC1102 is the audio output. Probably it contains a small complementary-symmetry output stage and the necessary drivers (the speaker is direct driven through a 100-microfarad capacitor).

Don't expect to use the volume control as a convenient test pont; there is no audio or AC voltages there. Control of the sound level is accomplished by variation of the DC voltage at pin 6 of IC1101.

There is one intermediate point where you can scope or inject audio. That's between the two IC's, at pin 8 of IC1101, and the input of IC1102 at pin 2.

The other audio test point is the speaker, which connects between module pin U14 and chassis. There are two negative feedback points connecting to the speaker wiring, but they are of no great help in testing.

Testing IC Circuits

Three main methods are recom-

Fig. 2 This complete schematic (left) of the 9-86 Zenith module is furnished by courtesy of Photofact, and is from Folder 1377-3.

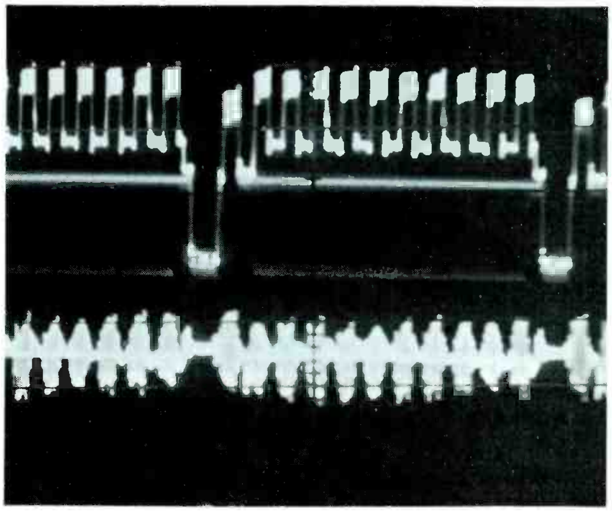


Fig. 3 Composite color input signal to the module at terminal U12 measured 1.5 volts PP (top trace). This bar generator produced black spaces between the bars. The groups of 3.58-MHz sine waves are at the tops of the small square waves. The bottom trace shows the .14 volt PP color bars waveform at pin 2 of IC1001.

mended for troubleshooting circuits containing IC's. They are: signal tracing; DC voltage analysis; and parts replacements.

Signal tracing

Use your scope to see if all the input waveforms are there, and that their amplitudes and waveshapes are correct. Most of the waveforms will be the same as those in tube-powered receivers, but generally the amplitudes are much less.

Signal injection is very effective, also. However, be careful of any DC charge left in coupling capacitors between generators and the transistors or IC's. Sudden discharge of a .05 or .1 microfarad capacitor at a sensitive element can ruin an IC.

DC voltage analysis

First, make certain all of the major DC supply voltages reach the module and the IC's. This seems elementary, but it's important.

Other DC voltages around the IC's possibly will deviate somewhat from the ones shown on the schematic. Signal levels, parts defects, and control adjustments cause many voltage differences. Experience and intuition must guide you here.

DC voltages with the IC removed, versus the voltages with it in socket

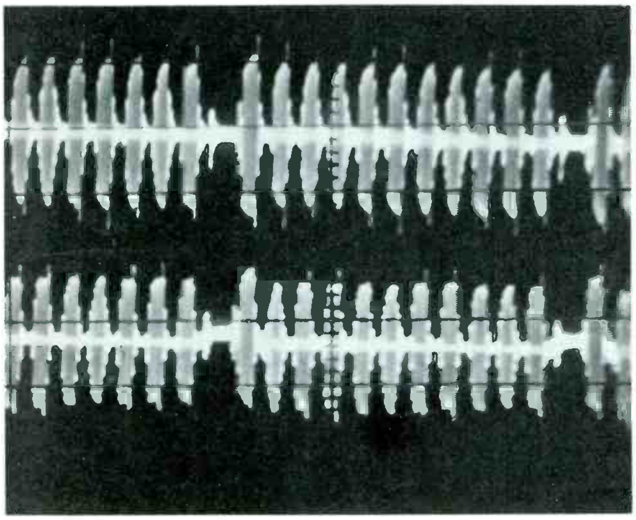


Fig. 4 These waveforms are nearly identical except for amplitude. At the top is the .6 volt PP bar signal at módule U14 (point "Q"); and the .24 volt PP signal at the bottom was found at pin 13 of IC1001.

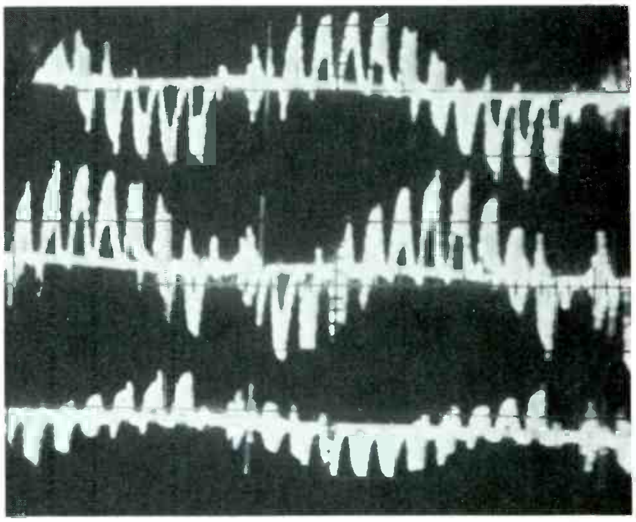


Fig. 5 This triple exposure shows the output of the demodulators. Top trace is 3 volts PP of R-Y signal at W7; center is 3.8 volts PP of B-Y at W3; and bottom is 1.5 volts PP of G-Y at W5. Blanking and video have not been added yet.

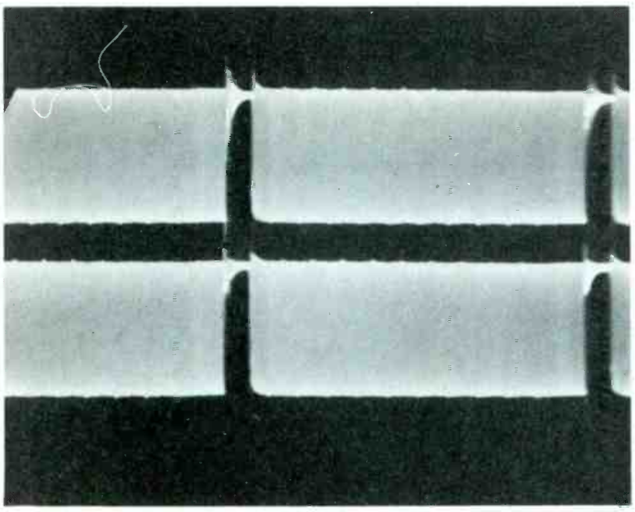


Fig. 6 Evidently blanking is applied to the 3.58-MHz demodulator signals (scope at horizontal scanning rate) rather than to the chroma signal. The R-Y carrier at W27 and the B-Y carrier at W25 both have same amplitude (1 volt PP) and waveshape, but different phase.

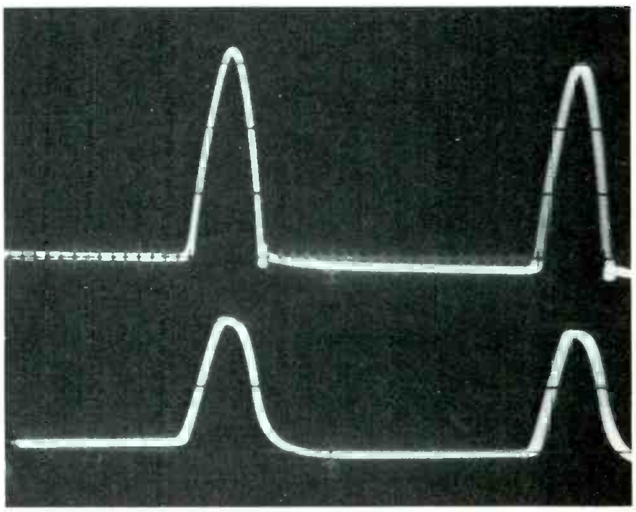


Fig. 7 Keying pulses are necessary for burst separation (and carrier blanking?). Top trace shows 7 volt PP horizontal pulses at W29; and 4 volt PP pulses at IC pin 4 are at the bottom.

often will indicate a problem that's DC-caused. Just be sure the power is off before you remove or reinstall IC's or transistors.

Parts and module replacements

Individual components, transistors, and IC's can be replaced in the circuits of the 19EC45 Zenith. Or, if the problem seems to be deep-seated or too time-consuming, complete modules can be replaced.

Availability of parts and modules, and the individual nature of the problem, will help you decide which method to follow.

Next Month

This ends the coverage of the 19EC45 series of Zenith color portables. Next month, the subject will be the TS941 Quasar. Would you believe a power-supply circuit that regulates by changing the length of time the rectifier current flows? □

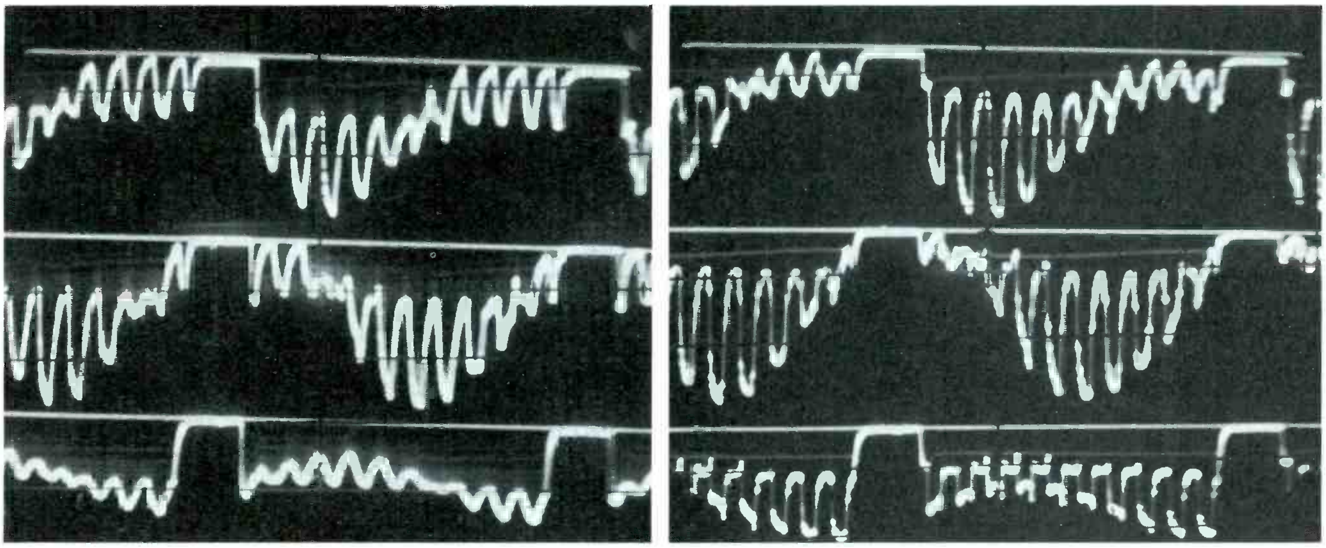


Fig. 8 Waveforms at the cathodes of the picture tube are different with video. Picture at left shows bars without video. Top trace is 60 volts PP red signal, center is 65 volts PP blue signal, and bottom is 24 volts PP of green cathode signal. Waveforms of the right picture are the same except the video (dark spaces between the bars) is included.

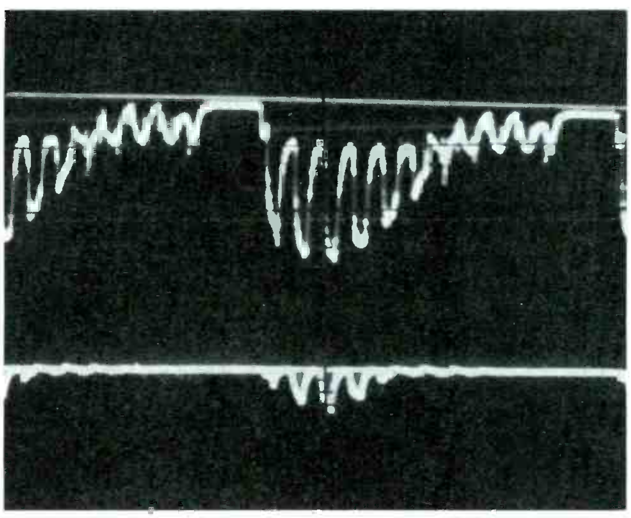


Fig. 9 When point "N" is bypassed by a 1 microfarad capacitor to remove the video from the matrixed color signals (as recommended by Zenith) the color bars are severely clipped. Top trace is the normal chroma and video waveform at the red CRT cathode. Clipped waveform of the bottom trace resulted from bypassing point "N". I recommend bypassing the center terminal of the contrast control, if you want to eliminate the video component, it doesn't distort the waveform.

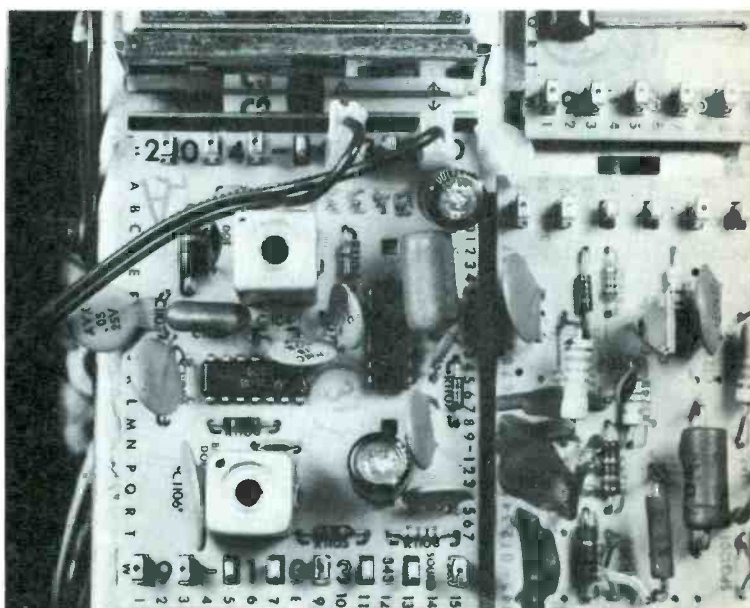


Fig. 10 On the left is the 9-103 audio module. The power-amplifier IC (IC1102) is the one on the right. IC1101 (IF amplifier, detector, and low-level audio) is at the left.

Reports from the test lab

By Carl Babcoke

Fig. 1 Some features of the RCA Master Chro-Bar generator Model WR-515A include the usual patterns and color bars plus Blank raster, Superpulse, and a selectable number of dots and lines. Also, the patterns can be obtained as standard video, or modulating an IF carrier or a Channel 3 carrier.

These monthly reports about electronic test equipment are based on actual examination and operation in the ELECTRONIC SERVICING laboratory. Observations about the performance, and details of new and useful features are spotlighted, along with tips about how to use the instruments for best results.

Color/bar generators have been around ever since the first color TV was offered for sale. I remember (without nostalgia) one dot/crosshatch generator that required synchronizing from the vertical and horizontal sweep circuits of the color receiver being converged. The idea was to lock the receiver to a TV station, then lock the generator to the set. Unfortunately, it usually was impossible to separate the two signals, so you suffered from a bouncing crosshatch, or the crosshatch was overpowered by the TV program.

Later, generators were available with crystal control of several functions, including keyed-rainbow color bars. These were fairly satisfactory, but offered only crosshatch, dots, and color bars. In addition, the horizontal and vertical frequencies were synchronized by divider chains that sometimes required relocking.

Modern color bars have many more features and patterns, and the sweep frequencies are obtained by digital count-down circuits which should never need adjustment.

Of course, the **RCA WR-515A** falls into this latter category. It is not limited to convergence and color-locking of receivers, but has applications in closed-circuit TV, and other areas.

Pushbutton Versatility

One good feature of the RCA WR515A Master Chro-Bar generator (Figure 1) is the many pushbuttons which select the various functions. I did a quick count and concluded that 20 different patterns could be selected by 10 pushbuttons. Also, by selecting the desired output jack and operating one more button, you can have those 20 patterns as video, on an IF carrier, or on the usual Channel 3. This makes a total of 60 functions. What's more, the IF and Channel 3 signals are available with either 75-ohms or 300-ohms impedance.

Patterns

The basic patterns are:

- keyed-rainbow color bars (with or without markers);
- Superpulse;
- blank raster (useful for purity adjustments);
- lines; or
- dots.

However, there are many variations of these.

Lines and crosshatch

Figure 2 shows three of the possible lines and crosshatch patterns. In addition, the lines or dots can be selected for either 3 or 10 vertically, and 3 or 11 horizontally. Thus a crosshatch can be formed in four different ways: 3 vertical and 3 horizontal lines; 10 vertical and 11 horizontal lines; 3 vertical and 11 horizontal lines; and 10 vertical and 3 horizontal lines. Dots can be arranged the same way.

Superpulse

The Superpulse appears on the screen of the picture tube as a large white rectangle (Figure 3), or a wide square pulse at both vertical and horizontal scope frequencies. It's useful for gray-scale tracking of color sets, or it can reveal ringing or smearing either on the picture or on a scope trace. This latter function is just as useful with b-w sets as it is with color receivers. You will find a proper generator signal to be far better for many kinds of analysis than is the station video.

In broadcast work, this kind of pattern is called a "white window" pulse.

Color bars

With two exceptions, the color bars are conventional. They are narrower than most, and the third, sixth, and ninth bars can be identified by a white stripe down the left side when the MARKER button (just below the COLOR button) is depressed (Figure 4).

The marker for the bars is very useful with sets that have horizontal overscan. Many of the transistorized horizontal-sweep systems have a long retrace time, so more of the sides of the picture is blanked out. Regardless of the reason for the excessive width, many sets show only 8 or 9 bars, and the markers are essential for positive identification.

Level of the chroma is determined by the CHROMA control.

Signal tracing color bars

Color-bar waveforms are ideal for signal tracing in the chroma channel. Most scopes have more than enough gain to show a good waveform, even at the take-off point. Use external horizontal sync for the scope by clipping a test lead around the insulation of the hot yoke wire, and connecting it to the external-sync input.

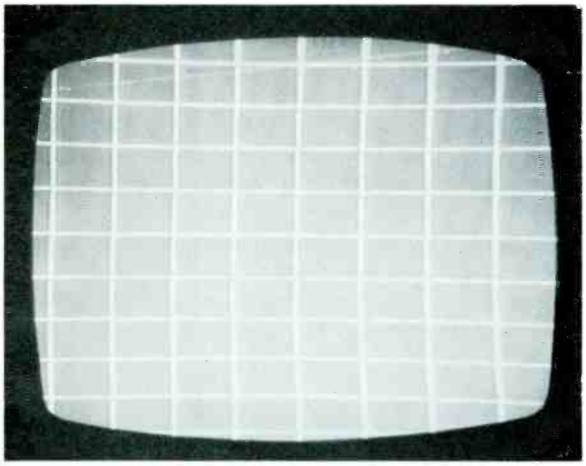
Some waveforms of the color-bar waveform from the generator, and the same signal after it passes through the video amplifiers to the picture tube, are shown and explained in Figure 5.

Signal tracing the lines

The generator signal with one of the lines patterns also can be useful for signal tracing (Figure 6). Some degradation of the waveform always occurs, but it doesn't take much practice before you can estimate the amount that is acceptable.

Video Output

The video waveforms (no carrier) of the patterns described are available at the VIDEO output jack. Just to the left is the LEVEL



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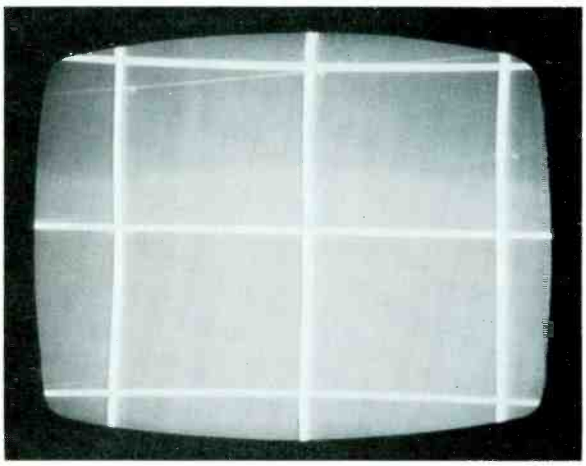

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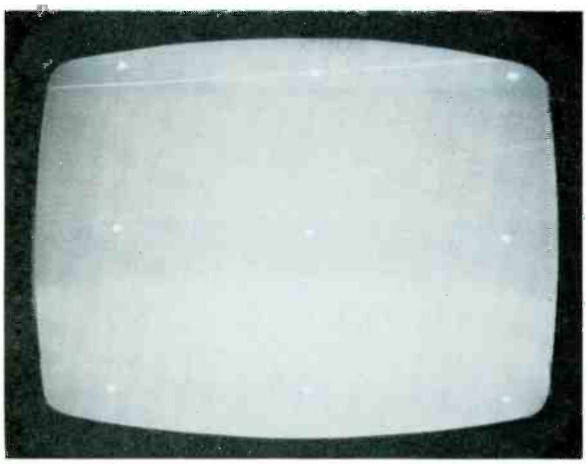

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Fig. 2 These are three of the many dots, lines, and crosshatch patterns to choose from. (A) The standard crosshatch is made by selecting 10 vertical and 11 horizontal lines. (B) Convergence can be done faster with 3 vertical and 3 horizontal lines without the extra lines that distract your attention. (C) Dots in a 3 vertical and 3 horizontal pattern are excellent for center convergence or a final touchup of convergence.

control which determines the polarity and level of the video signal. Zero amplitude is at the center of the travel, negative-going with increasing amplitude to the left, and positive-going polarity of increasing amplitude to the right. Impedance is standard 75 ohms, and the maximum amplitude is 2 volts PP, just twice that required by most video systems.

RF Outputs

One output jack and one LEVEL control are located at the lower-right corner of the panel. When the IF/45.75 MHz knob is in the normal (out) position, the RF output is a Channel 3 carrier that's modulated by the video of whichever pattern is selected. Push in on the knob so it latches and the output is the same video that's modulating a 46.75-MHz carrier. This signal is useful in signal-injection testing of video IF circuits.

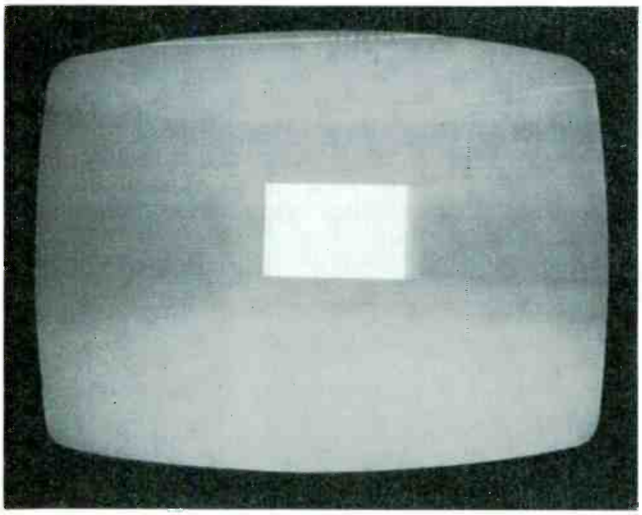
Impedance of either signal at the RF jack is 75 ohms, but the output cable has two plug-in heads. One is a direct/isolation type, and the other apparently has a balun coil that provides 300-ohms impedance. The 75-ohm impedance is standard for CATV and MATV systems (also some color receivers), and 300 ohms is correct for most receivers. Both impedances are obtained without any switching.

Both output jacks are the BNC type. The instruments come equipped with the output cable, one direct/isolation head, one 300-ohm head, and an instruction book.

Gun Killers

Three gun-killer switches are mounted on the front panel, with the four leads coming out of the back of the cabinet. Of course, killer switches are handy time-savers for convergence and purity adjustments on color receivers.

One note of caution: these are intended for connection to the three



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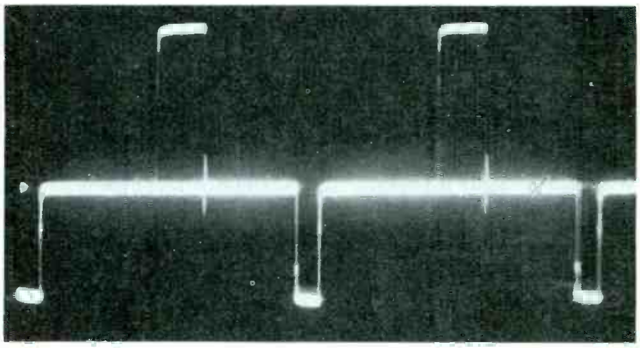

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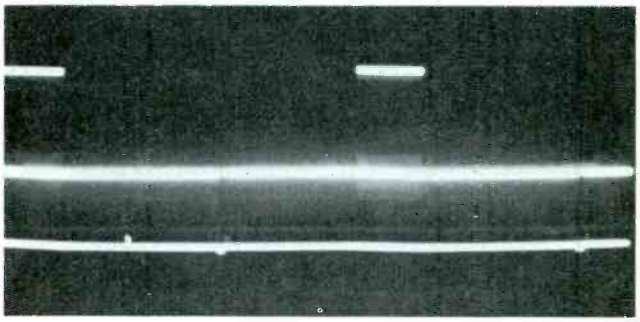

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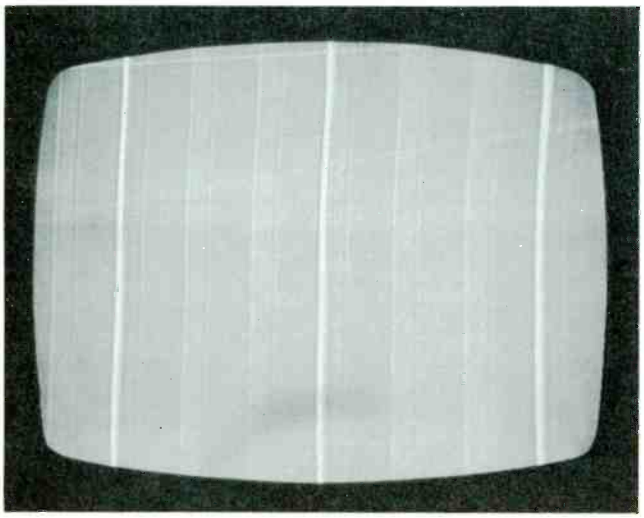
Fig. 3 The white rectangle made by the SUPERPULSE pattern checks DC restoration, ringing and smear. (A) This is the appearance of the Superpulse on the picture tube (camera shutter action has darkened part of the picture). (B) Video output direct to the scope at horizontal rate shows excellent waveform. (C) This is the same video Superpulse, but viewed at vertical rate.



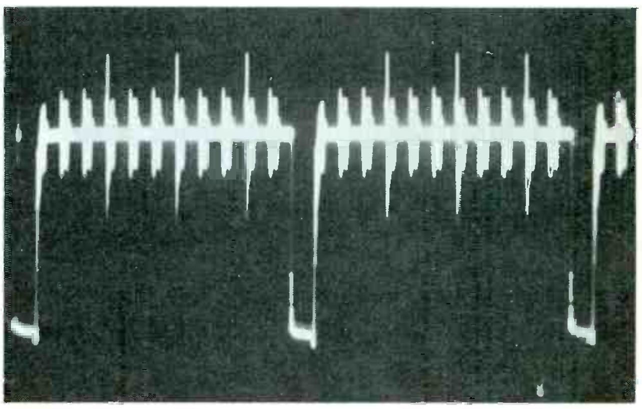


Fig. 4 The overscanned raster shows only 8 color bars, but the edge MARKER on the third, sixth, and ninth bar identifies each. Video from the generator shows the three markers in the scope waveform.

grids of color picture tubes. Do not use the killer switches on those few sets that have all control grids tied together. No damage will result, but turning off any color turns off all.

Comments

During our tests, the RCA Master Chro-Bar generator Model WR515A performed exactly as the specifications stated. Stability was perfect. □

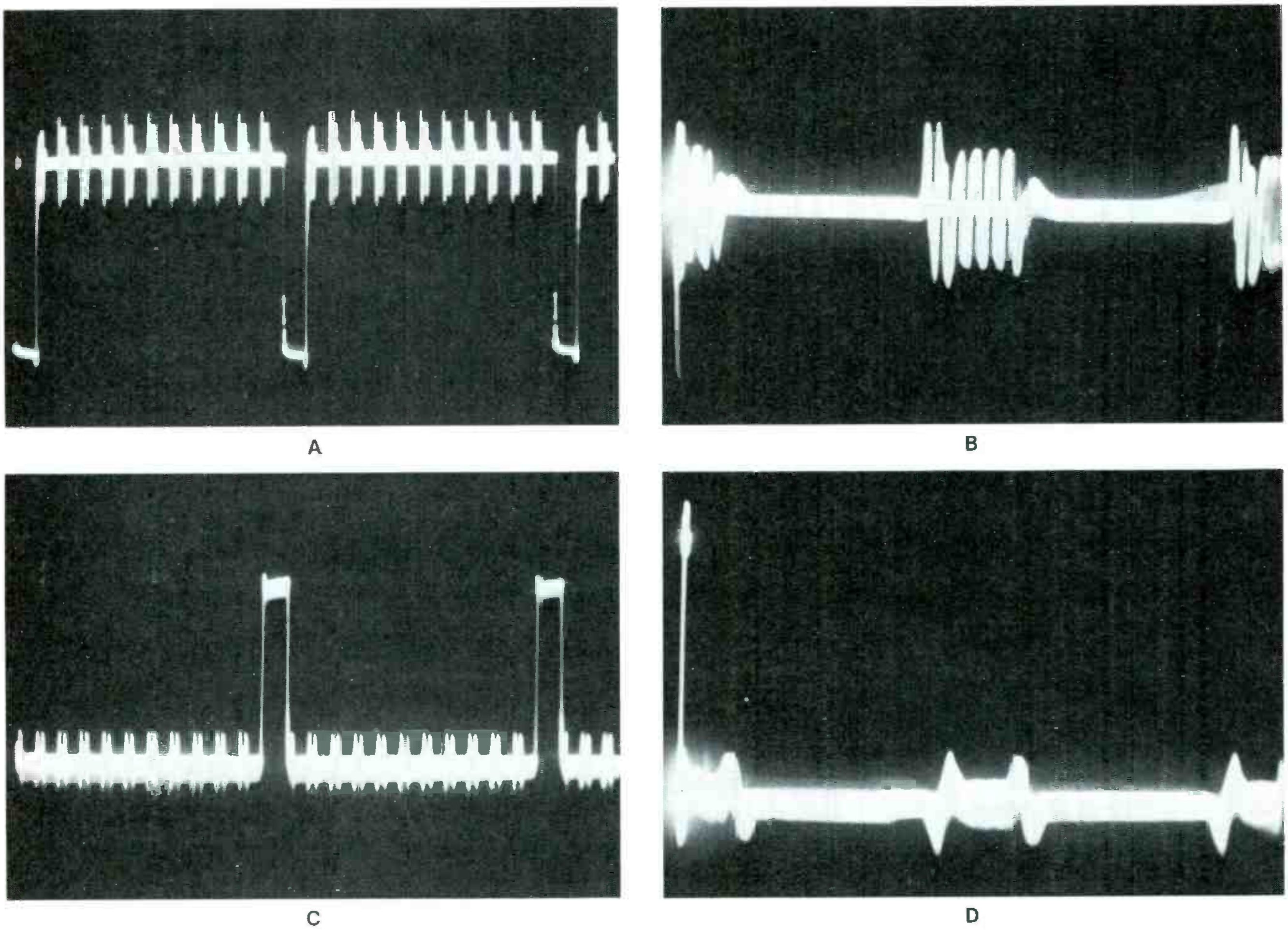


Fig. 5 The color bars have b-w video edge markers to show where the bars should be (test for the "fit" of b-w and color). Waveforms in (A) and (B) are the color bar signal direct from the video output of the generator. Compare them with the same signal appearing at the cathodes of a picture tube (a model that has chroma signals to the grids) as shown in (C) and (D). Notice the compression of the horizontal sync; this amount is probably typical of many older models. Most of the edge markers were in the original chroma signal, but were difficult to see because of the 3.58-MHz sine waves in the bars.

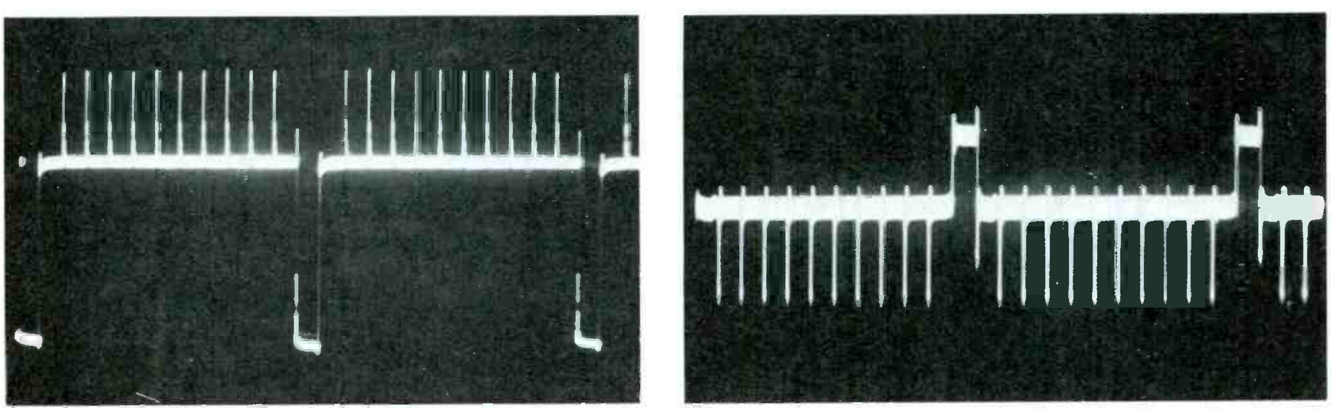


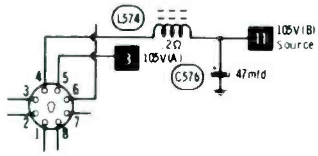
Fig. 6 Similar sync compression and increased ringing also can be seen in the scope waveforms of lines. In the left waveform, the signal is 10 vertical lines at the horizontal scope speed. It's negative-going video that's fed to a video stage. After passage through two video amplifiers, the sync is compressed and the spikes representing lines have excessive ringing (right waveform). This set was normal; do the same test with other receivers, and you soon will know how much change is normal.

troubleshooting tips

No DC power
MGA Model CS170
(Photofact 1343-1)

When the TV receiver came into the shop, the channel light was on, but there was no picture, no raster, and no sound. It was completely dead.

I knew that the regulator circuit for the +105-volt source would reverse bias the regulator transistors if a short caused excessive current. This is the defect I suspected. With the power off, I measured the resistance to ground of the 105-volt supply, using both standard and low-voltage ohmmeter ranges. There was no short or low resistance.



However, I believed excessive current to be the cause. From the schematic, I found an easy way of dividing the load for a test. A jumper between pins 4 and 5 of the yoke plug disconnects the 105B supply, which includes the horizontal-sweep circuit. With the yoke plug removed, and the power applied, the 105-volt A source worked okay, and the sound was heard. This isolated the short to the 105-volt B source.

While checking carefully around the flyback circuit, I found a 10-ohm short to ground from the cathode of D572, the diode rectifier for the +177-volt source. Only two circuits (video and vertical) obtain voltage from this point. The short should be easy to find; (I thought!).

With the video module removed, the short remained. So it must be in the vertical sweep. However, I searched everywhere without success.

To make a long story short, I noticed part of the printed conductor carrying the 177-volt line ran under C576. After the capacitor was removed, I found a carbonized spot between the line and the capacitor ground.

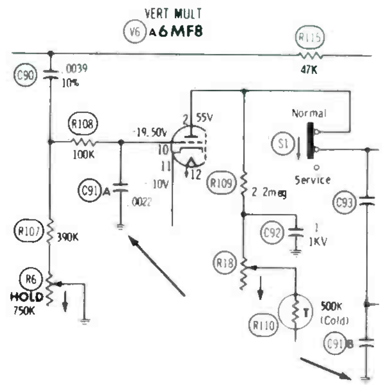
I removed about an inch of the 177-volt conductor, replaced it with a piece of insulated wire, and installed a new capacitor. That completed the repairs.

Lew Garrett
Albuquerque, New Mexico

Multiple vertical problems
Zenith 12A10C15 chassis
(Photofact 1067-2)

The sound was okay, but the picture was a single narrow horizontal line across the screen. Now, I've been on this detour before, so I didn't immediately pull the chassis, but checked the action of the set-up/normal switch. Neither position brought back the vertical height. These switches have been troublemakers, so I pulled the chassis and replaced the switch.

Height was about 5/8 normal, and the picture was rolling. I changed feedback capacitors C95 and C90. This stopped the rolling, but the picture still lacked about 2 inches at the top and at the bottom.



Then I noticed the heater of V6 (6MF8) vertical tube was not as bright as usual. At pin 12, a meter showed a normal 6 volts, but at pin 1 (which should have been grounded) the voltage was 3 volts! Capacitors C91A and C91B also connect to pin 1, so I used a test lead to ground the common wire. The heater brightened, and the height increased to normal. Further tests showed the wire between pin #1 of V6 and a grounding terminal strip had a bad connection at the strip. A few seconds with a soldering gun completed the job.

John McNevin
Milpitas, California

test equipment report

These features supplied by the manufacturers are listed at no-charge to them as a service to our readers. If you want factory bulletins, circle the corresponding number on the Reply Card and mail it to us.

Digital Multimeter

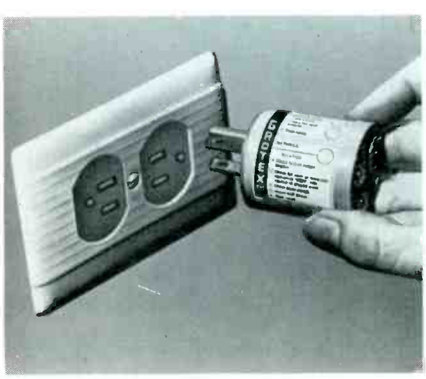
The latest addition to the **Heath/Schlumberger** line of low-cost high-performance instruments is the SM-1212 digital multimeter. Four ranges are provided for DC volts, DC milliamperes, AC volts, AC milliamperes, and ohms (there is an extra 200-ohm range). Accuracy is said to be 1% for DC volts, 1½% for AC volts and AC/DC current, and 2% for resistance. AC can be measured up to 700 volts.

Price of the factory-assembled instrument is $120.00, FOB the factory.

For More Details Circle (50) on Reply Card

Pocket-Sized Grounded-Outlet Tester

Testing for faulty wiring is fast and easy with the pocket-sized grounded-outlet tester from **The Custanite Corporation.** Called the Grotex, the troubleshooting device is inexpensive and requires no batteries or lead wires.



Simply plug the unit into any AC outlet and observe the indicator lights. Various light combinations indicate absence of power, reverse polarity, faulty connections or missing grounds. The lights also warn of the need for immediate service. A handy light-diagram chart is mounted on the unit for quick reference.

For More Details Circle (51) on Reply Card

Pocket-Sized VOM

A 20,000 ohms-per-volt VOM with 16 ranges has been announced by the **International Components Corporation.** Pocket-sized Model IC-210 reads resistances to 60 megohms, and current down to 50 microamperes.

Voltage sensitivities are 20,000 ohms-per-volt DC and 10,000 ohms-per-volt AC. The unit is built with two silicon diodes for meter overload protection.

Price of the IC-210 is $29.95, including carrying case, batteries, test leads, and instructions.

For More Details Circle (52) on Reply Card

Portable Digital Multimeter

Sencore's Model DVM32 3½-digit multimeter features high accuracy of readings, portability with a choice of power sources, and protection both electrically and mechanically.

The DVM32 can be operated from standard "C" cells, rechargeable ni-cads, or 120-volt AC outlets. Battery life is extended by the Auto position which turns off the LED display between measurements, thus reducing the current drain to 15 milliamperes.

Fuses are used on voltage, resistance, and current ranges, and all DC ranges are protected up to 2,000 volts. A high-impact Cycloac case is said to survive falls without damage.

Auto Polarity supplies a plus or minus sign for DC voltage or current readings; Auto Decimal correctly positions the decimal according to the range; and Auto Overrange lights a blinking 1,000 reading to suggest you switch to the next higher range.

Resistance readings can be made either with a test voltage of only .08 volts (to prevent conduction through solid-state junctions) or with a higher voltage that's necessary to test diodes.

Input impedance is 15 megohms on all voltage ranges, and a 200K isolation resistor in the probe can be switched into use to minimize capacitance loading of sensitive circuits. Accuracy on DC voltage measurements is .5%, with 1 mV resolution.

Model DVM32 is small, weighs slightly more than 2 pounds, and sells for $198.00.

For More Details Circle (53) on Reply Card

productreport

These features supplied by the manufacturers are listed at no-charge to them as a service to our readers. If you want factory bulletins, circle the corresponding number on the Reply Card and mail it to us

Heat-Sentry Alarm

Designed to protect any home or business from fire, the Heat-Sentry alarm horn sounds when room temperature reaches 131°F.

Manufactured by the **Audiotex Division of GC Electronics**, Catalog No. 30-9050 is convenient and easy-to-install.

For More Details Circle (54) on Reply Card

Bonding Liquid

Zipbond, a one-liquid contact cement, joins most man-made materials

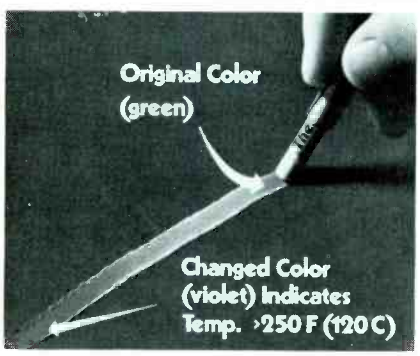
in just 60 seconds. No heat or pressure is necessary for the alpha cyanoacrylate system to bond rubber, metals, plastic, porcelains, woods, or glass.

According to the **Instrument Division of Tescom Corporation,** Zipbond has a tensile shear strength of up to 2770 psi.

For More Details Circle (55) on Reply Card

Temperature-Indicating Crayons

Rapid measurement of surface temperatures is possible now with Thermochrom® temperature-indica-



ting crayons. Eighteen crayons are offered from **Telatemp Corporation,** covering the temperature range of 150°F to 1240°F.

The crayon marks change color within 1 or 2 seconds if the surface temperature corresponds with that of the crayon. If the surface temperature is higher than the crayon value, the change is instantaneous; if lower, no change occurs.

The crayons come in kits of 6, 12, or 18. Kit 2820 contains 18 crayons covering the full temperature range, and costs $35.00.

For More Details Circle (56) on Reply Card

All-Purpose Tables

Two sturdy roll-around tables for a variety of in-shop uses has been introduced by **General Electric.**

The all-purpose table has a 24-inch square plywood top and can handle loads up to 250 pounds. For easy viewing of test equipment, the test table features an angled top at a 34-inch working height.

Both tables have heat-resistant plywood tops that resist marring and are insulated against shorts and grounds. A lower shelf is included with both models.

For More Details Circle (57) on Reply Card

Color TV Service Handbook

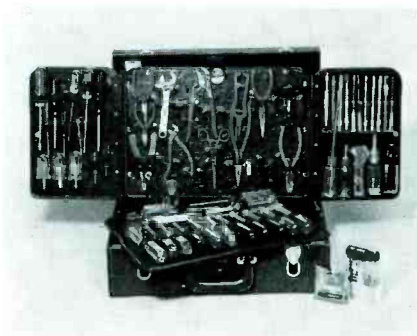
The fifth volume of **RCA's** Color TV Service Handbook provides specific service data for routine service adjustments and preliminary troubleshooting on 1973 and 1974 models of 16 set manufacturers.

Information in the handbook is based on each manufacturer's service notes. The 276 page text contains a chassis index, and is priced at $3.75.

For More Details Circle (58) on Reply Card

Compact Tool Case

The **Xcelite** TC-100ST tool case contains a total of 41 individual tools,



16 of the Series-99 interchangeable screwdriver/nutdriver blades and handles, and five specialized space-saving kits.

Included in the variety of multi-use tools are 7 types of pliers, an adjustable wrench, electrician's knife, electronic snips, straight nose seizer, and wire stripper with cutter. The sets and kits contain Phillips, slotted and hex screwdrivers, hex nutdriver blades, and a selection of handles and other specialty blades.

The case holds a removable pallet and tray with see-thru-plastic tool pockets. A smaller case, Model TC-200ST containing 38 tools and kit sets, also is available.

For More Details Circle (59) on Reply Card

Rechargeable Soldering Iron

A rechargeable soldering iron makes servicing hard-to-reach areas easier, and eliminates any possibility of leakage through the power line causing failure of FET's, or other delicate components.

Model 194 by **Ungar** has a NiCad-powered iron that will accept either of two interchangeable tips, and a charger/holder with a tip-cleaning sponge. Other features include a built-in lamp for illumination of the work area, and quick heating with an easy-touch switch.

For More Details Circle (60) on Reply Card

Metal Bin Boxes

Non-flammable steel bin boxes in five modular sizes from **Bay Products** are claimed to have advantages over others made of cardboard or plastic.

A variety of simple "visual inventory control" systems permits immediate retrieval of stored parts. The

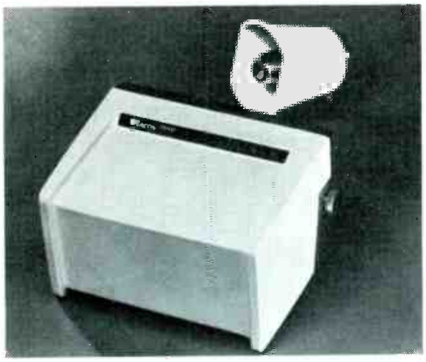
bin boxes are constructed with reinforced rolled edges and embossed sides for strength, yet are light and durable.

Large label holders are built-in, and are available with optional blank or pre-printed systems labels.

For More Details Circle (61) on Reply Card

Radar Motion-Detection System

Detection of moving intruders at ranges up to 100 feet is possible with



R4 Microwave Intrusion System from **Mountain West Alarm.** The local alarm is a distinctive yodel-type electronic siren, which reportedly can be heard one block away.

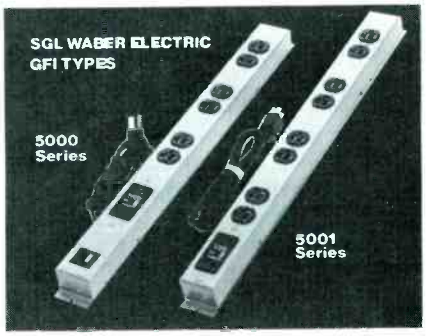
The 10.525 GHz microwave motion-detection system covers a 30° angle. Solid-state digital-circuit detection helps eliminate false alarms due to random vibrations. The detector can be placed on a shelf or permanently mounted.

For More Details Circle (62) on Reply Card

GFI-Protected Outlet Strips

Two series of outlet strips manufactured by **SGL Waber Electric** incorporate GFI (Ground Fault Interruption) protection of all outlets in the strips. GFI is a safety device that automatically interrupts power in 1/30th of a second when leakage of as low as 5 milliamperes is detected.

Model 5000 GFI series is controlled by a neon-lighted rocker switch with fuse or circuit breaker protection, and features 8 "U"-ground receptacles.

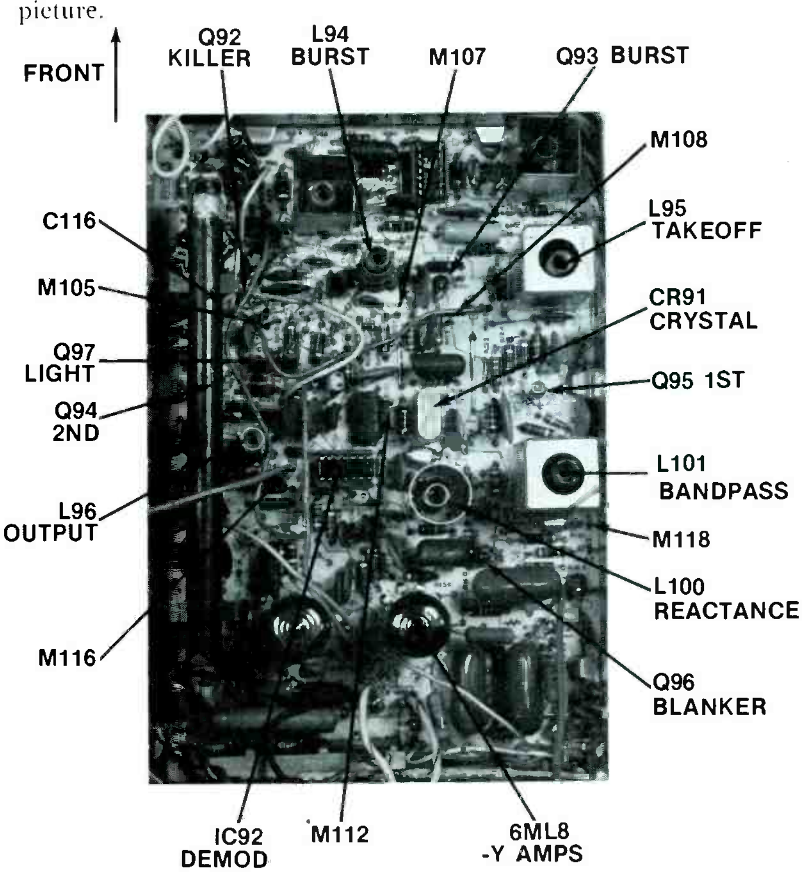


Model 5001 has 10 "U"-ground outlets. Both units offer a choice of 6- or 15-foot cord lengths. ☐

For More Details Circle (63) on Reply Card

CORRECTION

Something happened to move the negatives out of register after page 15 of the April, 1975 issue was approved. Consequently, the callout arrows pointed to the wrong chroma board areas of the Philco chassis 4CY80, 2CY80, and 3CY30. Here is the corrected picture.



audio systems report

These features supplied by the manufacturers are listed at no-charge to them as a service to our readers. If you want factory bulletins, circle the corresponding number on the Reply Card and mail it to us.

Servo Feedback Speaker System

The patented Erath servo-feedback system is incorporated into **C/M Laboratories'** new speaker line, "SmartSpeakers". The servo system

utilizes a sensing network that compares the mechanical analog of the speaker output with the applied electrical signal, and then generates a correcting voltage. This voltage is fed back to the amplifier to correct any distortion in the motion of the speaker's voice coil. Reportedly, other benefits from the use of servo feedback include improved transient response, reduced phase distortion, and increased dynamic range.

Three models are included in the "SmartSpeaker" line. Model 15 is a floor-standing 3-way system with a 15-inch woofer, 6-inch midrange driver, and two tweeters. Model 12 is a large bookshelf system with a 12-inch bass driver, 6-inch midrange, and a high-frequency tweeter. A smaller bookshelf system with a 10-inch woofer and cone tweeter is called Model 10.

For More Details Circle (66) on Reply Card

Wireless Sound System

Designed to convert any standard public address or recording system for wireless sound, the compact, battery-operated PRV-1 unit from **Edcor** consists of a lavalier radio-microphone/transmitter and a miniature receiver/antenna unit.

The lavalier microphone clips to clothing, leaving hands free; while the receiver mounts on any recorder or PA system and connects to the microphone jack input.

Designed for short distance operation, the solid-state unit is sold as a system only.

For More Details Circle (67) on Reply Card

Bass-Reflex Speaker System

A 2-way bass-reflex speaker system with tuned port which uses "total-energy response" for broad dispersion of sound without loss of tonal quality, has been introduced by the Onkyo Sales Section of **Mitsubishi International.**

Model 12 features a 10-inch woofer with a low-resonance cone; a 3-inch free-edge tweeter with duraluminum center for mid- and high-end sound dispersion; and a bass-reflex enclosure with tuned port to help increase the low frequencies.

Said to handle 40 watts maximum power, Model 12 includes a 2-way crossover network and rear panel control switch for adjusting high-frequency response to room acoustics or personal tastes.

The system sells for $129.95.

For More Details Circle (68) on Reply Card

Audio Signal Processing Center

With Model 919 audio signal processing center from **Bozak,** it's possible to blend three different two-channel stereophonic input signals. Each stereo channel has gain, bass, midrange, and treble controls.

Standard input channels include a phono input, microphone input, and switch-selected choice of tape, tuner, or auxiliary input. All pre-amplifier stages are on plug-in modules for ease of maintenance.

A panning circuit permits locating the microphone input position anywhere between left and right channels. Width of the output from mono to extra-wide can be selected by the stereo blend control. Mono, stereo, reverse stereo, stereo blend or reverse blend are offered on the mode selector. A cue selector makes it possible to monitor each of the inputs separately.

According to Bozak, wide dynamic range and frequency response help contribute to the low distortion for the unit (less than 0.1% over a frequency band of 20 to 20,000 hertz with full 10-volt output into a 200-ohm load).

Model 919 sells for $797 and is available in an optional walnut enclosure for shelf mounting.

For More Details Circle (69) on Reply Card

Phone Interconnect

Automatic Interconnect Device (AID) was designed by **Metro-Tech Electronics** to couple the telephone audio to a tape recorder, and turn on the recorder when the receiver is lifted. Connection can be made anywhere along the phone line, not necessarily at the phone. The automatic-switching action eliminates battery drain and wasted tape that otherwise would occur when the phone was not in use.

The AID device is priced at $24.95.

For More Details Circle (70) on Reply Card

What would you like to read in ES? Send in your ideas.

antenna systems report

These features supplied by the manufacturers are listed at no-charge to them as a service to our readers. If you want factory bulletins, circle the corresponding number on the Reply Card and mail it to us.

Single-Channel Pre-Amp

A new addition to the product line of **The Finney Company** is the Model G-25 VHF single-channel pre-amplifier. It is in a die cast metal housing to minimize radiated signals, and features 30 dB of gain, with a noise figure of less than 3.5 dB on VHF low channels, and less than 4 dB on high channels.

Skirt selectivity of the G-25 is -20 dB at 5.5 MHz from center frequency on low band, and -20 dB at 7 MHz from center frequency on the high band. This helps to eliminate interference from unwanted TV channels.

Input and output impedances are 75 ohms. The unit comes with power supply and mounting hardware.

For More Details Circle (71) on Reply Card

Matching Transformer Jumper

A 10-foot coaxial cable with molded-on 75-to-300-ohm matching transformer for connecting a TV or FM receiver to an MATV outlet has been introduced by **Jerrold Electronics.** The cable is low-loss RG-59 coax with a copper-clad steel center conductor, foam polyethylene dielectric, a copper-clad aluminum braid, and a white polyethylene jacket.

One end of the cable is equipped with a snap-type SF-56 fitting which pushes onto any F or G connector. The other end of the cable has an all-channel matching transformer for connection to the antenna input terminals on any TV set.

Model CAD-10-TSF is priced at $6.50.

For More Details Circle (72) on Reply Card

All-Channel Antenna

Manufactured by **S&A Electronics,** the new Target CVU magnetic-log antenna features a patented UHF corner-reflector design with magnetically-driven array that is said to give improved reception of VHF, UHF, and FM stereo.

An elaborate isolation network to phase the magnetic UHF signals to the log-periodic VHF signals is not required. Mechanical connections which can loosen or corrode are eliminated, because the dipole signals are magnetically coupled to the drive lines.

For More Details Circle (73) on Reply Card

MOVING?

Send your new address to:

Circulation Dept.
Electronic Servicing
1014 Wyandotte Street
Kansas City, Missouri
64105

For More Details Circle (14) on Reply Card

For More Details Circle (15) on Reply Card

letters to the editor

Dear Editor:

Criticism of manufacturer's warranty practices and the unavailability of parts seems justified; I know some things have made me very unhappy. I have just waited over two months for a certain brand of color yoke; part of the delay was because I was asked to pay in advance.

The main trouble seems to be the constant changing of design. Why can't companies that now are going strictly modular stick to one kit of 12 modules that will replace all for a ten year period? Improvements could be incorporated without a change in size, shape, or connections.

Also, why don't all companies list transistors as 2Nxxx, instead of a dozen or more different numbers for replacing 2N176?

Yes, we need **standardization,** *not diversification.*

Sincerely,
George Skilling
Danville, Quebec

reader's exchange

Needed: *Old radio manuals and text books. Original factory material on early sets. Also need radio magazines published before 1940.*
Lawrence Beitman
Illini Tower, Room 610
409 E. Chalmers
Champaign, Illinois 61820

Needed: *Schematic, manual, or any information about Aul Instrument Company oscilloscope, Model 055.*
Francis J. Piraino
Box 86
Pocono Summit,
Pennsylvania 18346

Needed: *Schematic for an antique jukebox made by the Gabel Manufacturing Company of Chicago, Illinois. Also need tubes for the amplifier, #418 JGIL.*
Robert S. Whitmore
4513 New Kent Avenue
Richmond, Virginia 23225

Needed: *Schematic and service information for Pilot II Model RDF-404, serial 82248, manufactured by Novatech.*
Walter L. Fenska
4729 Palm Beach Boulevard,
Lot 27
Fort Myers, Florida 33905

Needed: *Deflection yoke assembly RCA 906192-501, stock number 67115970, used in T-1 kit supplied by Sylvania Technical Schools.*
M. C. Womack
Route 1, Box 173-X
Mathis, Texas 78368

Wanted: *Used Wintronix color rainbow generator Model 150 or 750, in working condition and with manual; reasonably priced.*
Edward Schoener
P.O. Box 44
New Ringgold, Pennsylvania
17960

People start pollution.
People can stop it.

Needed: *Schematic for Mark 1 Argyle calculator.*
W. T. Sanders
5314 Ramona Boulevard
Jacksonville, Florida 32205

Needed: *2EP4 picture tube for Philco Safari b/w TV, Model H-2010. State price.*
R. Meixner
211 Main Street
Darlington, Wisconsin 53530

Needed: *Manual for Porter Electronic Laboratories RF millivoltmeter, Model 626. Willing to pay a reasonable price.*
G. R. Bosworth
P.O. Box 66577
Los Angeles, California 90066

Needed: *Two #35D5 tubes for Capehart Model P4AS38.*
Bill Nickoloff
21215 Hunt Club
Harper Woods, Michigan 48225

Needed: *Picture tube for Symphonic mini-TV, Model TPS-5050.*
Stan Pindjak
10907 West 49th Terrace
Shawnee Mission, Kansas 66203

Needed: *Diagram for Superior Instrument volt-ohm-meter Model 670A.*
Martin Mueller
11900 New Halls Ferry Road
Florissant, Missouri 63033

Needed: *Power transformer for Symphonette Model LCR500.*
Joe Beatty
4523 Saint Rita Lane
Columbus, Ohio 43213

Needed: *Model 21-56 Compact Meter-Matic VTVM, in good condition.*
J. Brousek
4704 Bragdon
Cleveland, Ohio 44102

For Sale: *Many obsolete radio tubes. Write me which ones you need.*
Elmwood TV, Inc.
136 Market Square
Newinton, Connecticut 06111

Needed: *Schematic and data for antique Majestic radio, Model 7.*
Maurice King
566 West 10th Street #308
San Pedro, California 90731

catalogs literature

Circle appropriate number on Reader Service Card.

100. Fordham Radio Supply Company—this discount mail-order catalog includes tools, service and repair kits, tubes, test equipment, phono cartridges and needles, speakers and microphones, antennas, components and many other servicing aids of major manufacturers. The catalog is illustrated and products are shown with discounted prices.

101. Cleveland Institute of Electronics—makes available a booklet entitled **How You Can Get Your FCC License.** Answering the where, when, how, and why questions for obtaining an FCC license, the booklet covers basic requirements, and gives typical questions on the exam.

102. Kester Solder—covering the Kester line of solders, flux-core solders, and soldering fluxes, the 8-page catalog describes more than 50 solders and related items.

103. Advance Schools, Inc.—has published a 6-page pamphlet describing its radio and TV service course. Course topics and career opportunities are discussed briefly.

104. Data Technology Corporation—the brochure describes and illustrates Model 21, a palm-sized 3½-digit multimeter that measures capacitance, AC volts, DC volts, and resistance. The $269.00 model is designed for field or bench operation.

105. Xcelite—bulletin 274 gives specifications and prices on a variety of new metric hand tools and sets from Xcelite.

106. Jersey Specialty Company—has issued a catalog featuring its line of wire and cable products. Included are illustrations and descriptions of coaxial cable, rotor wires, parallel cord, and speaker wire.

107. SGL Waber Electric—is distributing catalog No. 100 which features over 250 electrical power outlet strips, and 21 wheeled utility carts.

108. Electronic Devices—describes silicon rectifiers such as bridges, axial lead, high-voltage packs, cartridges, Solid-Tube®, and other special device rectifiers. The short-form catalog contains 12 pages of electrical characteristics, dimensional drawings, and photos of the complete product line of rectifiers.

109. General Electric—the 20-page brochure is designed to help independent service dealers build business and goodwill. The catalog covers such items as outdoor signs, business cards, service clothing and service aids.

110. Belden—a single-source selection and application guide for CATV-MATV coaxial cable offers a full product line and technical reference data on shielding methods and efficiency evaluation. Physical and electrical characteristics of more than 50 Belden CATV/MATV cables are presented in easy-to-read tabular format.

111. Brookstone—the new catalog features hard-to-find tools and other useful items sold rarely by industrial distributors. A year's free subscription (six issues) is offered.

112. Vaco—the Answer Book provides technical information and reproducible copy for distributors to prepare their own catalogs, or for conversion to micro-fiche for cost and space-saving reference. All type is large and easy-to-read.

"I can't figure it out, we haven't had a customer all day!"

"I keep hearing voices, Doc. My transistor radio is stuck in my ear."

photofact bulletin

PHOTOFACT BULLETIN lists new PHOTOFACT coverage issued during the last month for new TV chassis.

BRADFORD
1171D35 (WTG-80457), 1171G45 (WTG-80655) 1485-1

JC PENNEY
2365A, 2366A 1449-1

JVC
7830 1473-1

MGA
CS-172, CS-177 1475-1

MIDLAND
15-092 1473-2
15-019 1482-1

PANASONIC
CT-934 (Ch. ETR-81 Revised) 1481-1
Chassis T126A 1484-1

PHILCO-FORD
Chassis 5BL23, 5BL23/C 1482-2
Chassis 5BL26, 5BL26C 1486-1

QUASAR
Chassis ATS-/CTS-/TS-/YTS-942 1483-1

SANYO
Chassis TB-73000 1486-2

SEARS
528.44760400/770400/780400/790400 (Series) 1483-2
562.40020400/1400 1485-2

SONY
KV-9200 (Ch. SCC-65A-A) 1482-3
Chassis SCC-64A-A/-B 1484-2

SYLVANIA
Chassis E08-1/-2/-3 1481-2
Chassis E10-1/-3 1477-3

TOSHIBA
Chassis TAB-9910, TAT-8018, TAT-8019 1486-3

ZENITH
Chassis 22FB12 1484-3

bookreview

TTL Cookbook
Author: Don Lancaster
Publisher: Howard W. Sams & Co., Inc. 4300 West 62nd Street, Indianapolis, Indiana 46268
Size: 335 pages, book number 21035
Price: $8.95 paperback

Transistor-Transistor Logic (TTL) is a versatile and fast way of performing logic operations. TTL was preceded by RTL (Resistor-Transistor Logic) and DTL (Diode-Transistor Logic), which have found many applications in digital logic. With the introduction of TTL the scope of application has increased greatly. Instead of using traditional design methods, the concept of **redundancy** is used in TTL. In this concept, a more general or more universal logic block is used and then restricted to perform the desired task. Working directly with the truth table to solve the problem, this method often is a one-package solution, and gives the desired result with designs that take fewer packages and less time than traditional "minimum" designs. The purpose of the book is to show what TTL is, how it works, and how to use it. Lancaster includes a catalog of TTL devices, basic logic and advanced logic designs, a discussion of gate and timer circuits, and chapters on clocked logic, JK and D-type flip-flops and applications, counters and counting techniques, shift-register circuits, noise generators and rate multipliers. The final chapter discusses practical applications; including digital counter and display systems, events counter, electronic stopwatch, digital voltmeter, digital tachometer, and other digital instruments. Lancaster suggests several TTL projects the reader can try.

First-Class Radiotelephone License Handbook, Fourth Edition
Author: Edward M. Noll
Publisher: Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Indiana 46268
Size: 415 pages, book number 21144
Price: $7.50 paperback

This updated edition is designed as a study guide for obtaining a first-class radiotelephone license. Some subjects covered in the theory section include station frequency assignments; broadcast duties; microphones; recorders and tape players; studio and control room facilities; AM and FM transmitters; stereo broadcasting; and antennas and transmission lines. A series of questions and answers from three simulated examinations are presented in multiple-choice form with evaluations to help the reader find his weak areas. Three appendices contain extracts from the FCC Rules and Regulations for use as reference material. □

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.

FOR SALE

NEW Canadian Magazine "Electronics Workshop". $5.00 yearly. Sample $1.00. Ethko, Box 741, Montreal "A" Canada. 10-74-12t

UNUSUAL SURPLUS AND PARTS Catalog. $1. ETCO Electronics Dept. E.S., Box 741, Montreal "A" H3C 2V2. 12-74-12t

LOW NOISE RESISTORS - ¼W, 5%, carbon film from 10 - 3.3 Megohm for 3½ cents. Fifty of one value for $1.25. 1N4148 diodes for 6 cents. 75 cents postage. Free samples/specifications. Components Center-ES, Box 134, New York, N.Y. 10038 3-75-6t

HARD-TO-FIND TV & Radio Parts, New & Used. Ask Anyway. CMC 4329-4 Woodman, Sherman Oaks, Calif. 91423 3-75-6t

ADVERTISING PACKAGE FOR TV service shops. Inexpensive eye catching ads contain personal message from you-build customer confidence. Keeps your name before the public weekly. PROVEN RESULTS. Thirty ads with instructions $19.95. Sample $1.00 refundable. TV TIPS, 430 South Jefferson, Lebanon, Mo. 65536. 5-75-4t

B & K 1077B Analyzer, half price $227. Good condition. Box 71, Boston, Mass. 02199. 5-75-2t

CONVERT any transistorized TV tuner to a tuner substituter. Plans $2.00. $35.00 for completed and tested super substituter. **RADIO TELEVISION TRAINING**, Box 279, RE-35, Syracuse, NY 13206. 6-75-1t

RADIO AND TELEVISION equipment only six months old at low, low price. We have 9 Model 1077B B&K Television Analysts, $190.00 each. We have 12 Heath Model 10-102 Oscilloscopes only $125.00 each. We also have 12 Heath Model 1M-2202 Digital Multimeters (portable) only $100.00. Send Certified Check or Money Order for quick delivery or send 10%, balance COD. HURRY, SUPPLY IS LIMITED. Wholesale Imports Company, Technical Dept., Route #1, Box 216, Murphy, North Carolina 28906. 6-75-1t

FOR SALE (CONT'D)

DISCOUNTS TEST EQUIPMENT, parts. B&K, Sencore, RCA. B&K model 1246 color bar generator reg. $156.00, now only $132.60. Pomona 30KV high voltage probe $29.95. Others, list 10. F&M Electronic Dist., P.O. Box 236, Dept. K. Masp. Qns., N.Y. 11378. 6-75-4t

FLUKE Digital Multimeter (8000A-01) with rechargeable battery pack, $275.00. Sencore Color Bar Generator (CG-159), $75.00. Sencore Sweep & Marker Generator (SM-152), $335.00. Sencore Duel Trace Triggered Scope (PS-163), $500.00. All like new, send money order. Richard Sanderford, 6400 Andy Drive, Raleigh, N.C. 27610, (919) 834-3504. 6-75-1t

NEW Sencore Mighty Mite tube checker, $85.00. Heath vectorscope/color generator, $85.00. Horsley, 67 Theodore St., Buffalo, NY 14211. 6-75-1t

EDUCATION-INSTRUCTION

REPAIR TV TUNERS—High Earnings; Complete Course Details, 12 Repair Tricks, Many Plans, Two Lessons, all for $2. Refundable. Frank Bocek, Box 3236 Enterprise, Redding, Calif. 96001. 6-75-4t

BUSINESS OPPORTUNITY

FOR SALE Established Television Sales and Service Business located in the growing Front Range area of Colorado. For further information write: S. Ellis, P.O. Box 1947, Evergreen, Colorado. 80439. 5-75-2t

BUSINESS FOR SALE—in operation for 15 years. Service contracts for Admiral, Magnavox, GTE Sylvania and Zenith. Building 40 x 60; two floors, all air conditioned with 20 x 40 garage equipped to service our 5 trucks. Second location 20 x 80 building. This company is a service man's service shop. Radio dispatched, top reputation. D.&B. Rated. Write Starlight Radio & TV, 1551 Montauk Highway, Oakdale, L.I., N.Y. 11769; Phone (516) 589-4424. 6-75-1t

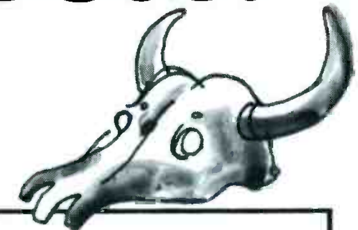
TELEVISION SALES AND SERVICE. RCA and PANASONIC franchise, citizens band radio and accessories, includes all stock, equipment and van. Located on the central coast where the pines meet the ocean. No real estate involved. $20,000 down. P.O. Box 1314, Paso Robles, Calif. 93446. 6-75-1t

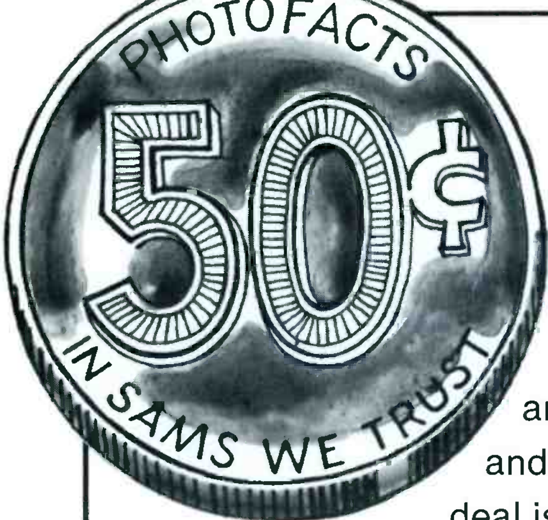
advertisers' index

WANTED:

Old Photofact® Sets!

We pay 50c each for old Photofact sets on our new Photofact Trade-in Program (TIP)!





Now, old Photofact® sets that you no longer need or use are worth 50¢ each on a trade-in for new sets! Here's your chance to update your servicing library with new Photofact sets that better answer your present-day servicing needs—and do it at a handsome saving. The TIP deal is this:

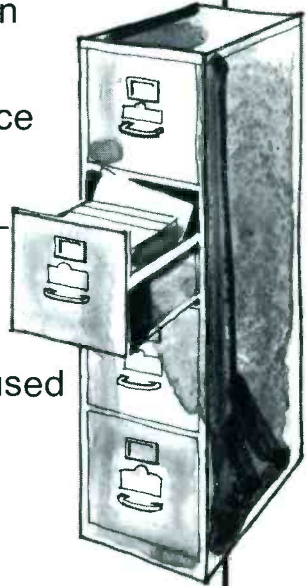
You must buy at least 60 new sets at one time.

We'll give you a trade-in credit of 50¢ per set for up to 200 new sets bought, but you cannot trade in more sets than you purchase.

Thus, every old set you trade in reduces the price of a new Photofact set by 50¢!

In addition, TIP offers still another money-saver-an order for 200 sets qualifies you to buy a 4-drawer Photofact metal file cabinet ($62 value) for only $35!

So dig out those dust covered sets you haven't used for years—call your Photofact distributor for details—and let's trade!



HOWARD W. SAMS & CO., INC.
4300 West 62nd Street, Indianapolis, Indiana 46206

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SUBBER™

TV Service Instruments for signal circuit analyzing.

When Castle introduced the TV Tuner SUBBER*analyzing instrument a couple of years ago it became the first practical way to easily test the VHF tuner, UHF tuner and i.f. amplifier system of any TV receiver. Being lightweight, self contained and battery powered the TV Tuner SUBBER* Mk. IV is the first such instrument which may be carried on service calls and used with ANY color or black and white TV receiver . . . at $45.95 for the battery powered Mk. IV, or $52.95 for the a.c. plus battery powered Mk. IV-B the instruments have been known to pay for themselves in TIMESAVING in the first two weeks of use!

Now we have introduced the Mk. V Master SUBBER*, an instrument which is absolutely unique . . . there is nothing else like it anywhere! It is completely portable and battery powered, practically foolproof in it's simplicity of operation when testing ALL the signal stages of any color or black and white TV receiver. The substitution signals available allow tests of the following stages: VHF tuner, UHF tuner, each video i.f. amplifier, video detectors, video amplifiers, 4.5 MHz sound i.f. amplifiers, sound limiter, sound detector and audio amplifier. It includes a signal level meter for testing the antenna signal. Inbuilt telescopic antenna makes the meter adaptable for true field strength measurements. Inbuilt monitor loudspeaker ensures foolproof substitution tests . . . every time!

At $169.95 the Master SUBBER* instrument is the best bargain in an analyzer that has ever been available. It will save oodles of time in the hands of a professional troubleshooter . . . and help advance the novice to professional status.

All SUBBER* instruments come complete with batteries, connecting cables and comprehensive instruction manual. The Master SUBBER* comes complete with wall plug-in transformer for 120vac 60Hz operation.

As an added bonus, all SUBBER* instruments enable use of the high speed agc system analyzing procedure invented by Castle . . . the first practical method for analyzing agc system defects without confusion.

*A registered trademark of Castle TV Tuner Service, Inc.

These instruments boast the extra features of all Castle products — advanced technology — modern styling — and they work!

If you need to save some analyzing time . . . you need a SUBBER* instrument!

See your stocking distributor . . . or write for more details and complete specifications.

CASTLE TV TUNER SERVICE, INC.
5701 N. Western Ave., Chicago, Illinois 60645 Phone: (312) 561-6354

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