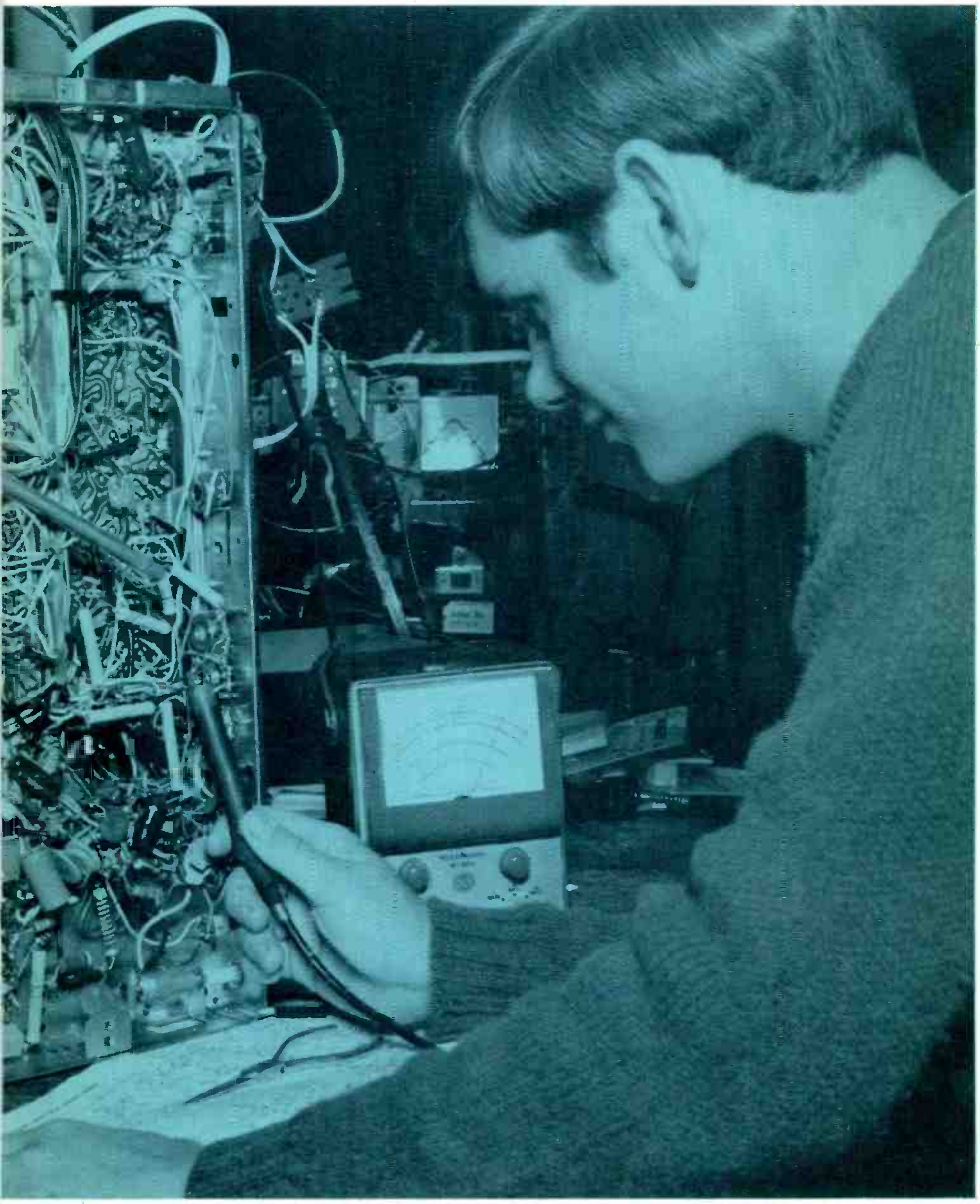
August, 1971 ☐ 75 cents

A HOWARD W. SAMS PUBLICATION

# Electronic Servicing



Signal and No-Signal Voltages In TV,
page 22

SHOP MANAGEMENT:

Data For Shelf and Caddy Tube Inventories,
page 37

What Operating Ratios Tell You,
page 18

# GE is bringing in panels of independent experts to tell us how to make our new products more serviceable.

They tell us. And we listen. And we'll have better products for it. This is just one of the things that GE has been doing to improve the serviceability and parts availability of our television products.

For the last several months we have been paying the transportation on warranty parts. We've also installed direct telephone lines to regional parts centers. And, soon, we'll have three hundred independent parts distributors throughout the country.

We're out to make GE television products as easy and inexpensive to service as possible. We have a little way to go yet. But we're doing something about it.

For additional information about GE service, call collect or write "Dutch" Meyer.

**GENERAL ELECTRIC**

Television Business Division • Portsmouth, Virginia • (703) 484-3521

# Update your Radio/TV skills with these aids

Completely up-to-date, written by experts and easy to follow . . . they are "best sellers" to radio/TV technicians and amateurs alike.

## COLOR-TV FIELD-SERVICE GUIDES


Invaluable for servicing Color-TV in the customer's home. Each volume contains 80 diagrams covering over 3,000 chassis . . . sensibly organized with detailed chassis layout charts on one page and specific adjustment procedures on opposite page. Indexed for instant reference.

**Vol. 1 No. 20796—$4.95**
**Vol. 2 No. 20807—$4.95**
**Vol. 3 No. 20847—$4.95**

## TRANSISTOR AUDIO AMPLIFIERS

By Jack Darr


Gives you a good, working knowledge of transistor circuits found in audio equipment of all sizes. Shows how the circuits work normally, what changes take place when trouble occurs, and how to service the solid-state equipment. An invaluable guide for all who service transistor circuits. **No. 20838—$5.50**

## 1-2-3-4 SERVICING TRANSISTOR COLOR TV

By Forest H. Belt and Associates


Details the simple 1-2-3-4 servicing method and steps that get transistor Color-TV sets fixed easily and right every time. **No. 20777—$4.95**

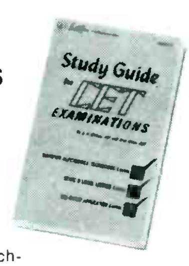
## 1-2-3-4 SERVICING AUTOMOBILE STEREO

By Forest H. Belt & Associates


Explains the simple 1-2-3-4 servicing method, shows how easy it is to apply the method to automobile stereo, fm multiplex, and tape cartridge systems. Clear, easy-to-read illustrations, charts and schematics to make servicing easy. **No. 20737—$3.95**

## STUDY GUIDE FOR CET EXAMINATIONS

By J. A. Wilson, CET and Dick Glass, CET




A comprehensive review of the material covered by the CET (Certified Electronics Technician) examination. It's almost a "must" for gaining a CET designation, for passing a state or local licensing exam, or as a "brush-up" in applying for a position in the electronics field. Includes question-and-answer sections and a 50-question test in each chapter. **No. 20834—$5.95**

## UNDERSTANDING OSCILLATORS

By Irving M. Gottlieb


What you want to know about oscillators . . . how they work, their many personalities and variations, strong and weak points, how they are used in practical applications, how to service them. A most useful text for engineers and technicians. **No. 20837—$4.50**

## 99 ELECTRONIC PROJECTS

By Herbert Friedman


An intriguing, easy-to-follow book for hobbyists as well as those experienced in electronics. Covers sixteen groups of projects, including audio, photography, automotive, remote controls, lamp and motor control circuits, etc., many of which can be built inexpensively. **No. 20818—$3.50**

## 101 QUESTIONS AND ANSWERS ABOUT CB ANTENNAS

By Jim Ashe

Best overall guide to the selection and installation of the proper antenna for your Citizens band radio. An ideal guide for beginners, it also answers questions about how to improve performance and range of already operating equipment and to repair and maintain CB antennas. **No. 20749—$2.95**

## CITIZENS BAND RADIO HANDBOOK, 4th Edition

By David E. Hicks


Now that two-way radio is available to any citizen, this revised edition answers the many problems and questions of all who use, or plan to use, CB equipment. Covers how to obtain a CB license, operating procedures, equipment, accessories, circuit analysis, servicing data, trouble-shooting hints, etc. **No. 20839—$4.95**

## SECOND-CLASS RADIOTELEPHONE LICENSE HANDBOOK, 4th Edition

By Edward M. Noll


Information needed to pass the 2nd class FCC radiotelephone exam. Questions and answers are based on the FCC exam for Elements I, II and III. Also covers communications theory and practices, solid-state two-way equipment. FCC Rules and Regulations, operating practices and procedures, reference date, etc. **No. 20824—$6.50**

**You'll find everything you want to know about Radio or TV in the modern Sams Technical Library. Send for our free catalog.**

Howard W. Sams & Co., Inc.
4300 W. 62nd St., Indianapolis, Ind. 46268

**HOWARD W. SAMS & CO., INC.**

Order from your Electronics Parts Distributor, or mail to Howard W. Sams & Co., Inc., Dept. ES081
4300 West 62nd Street, Indianapolis, Indiana 46268.

Send books checked at right. $________ enclosed.
Please include sales tax where applicable.

☐ Send FREE 1971 Sams Book Catalog.

Name ______________________
(Please Print)

Address ______________________

City ____________ State ________ Zip ________

| | |
|---|---|
| ☐ 20796 | ☐ 20834 |
| ☐ 20807 | ☐ 20837 |
| ☐ 20847 | ☐ 20818 |
| ☐ 20838 | ☐ 20749 |
| ☐ 20777 | ☐ 20839 |
| ☐ 20737 | ☐ 20824 |

*Circle 4 on literature card*

August, 1971 • Volume 21, No. 8

# Electronic Servicing

## in this issue...

### SHOP MANAGEMENT



### TV (GENERAL)



### HOME AUDIO



### AUTO ELECTRONICS



### COLOR TV



### DEPARTMENTS



Second class postage paid at Kansas City, Mo. and additional mailing offices. Published monthly by INTERTEC PUBLISHING CORP., 1014 Wyandotte St., Kansas City, Mo. 64105. Vol. 21, No. 8. Subscription rates $5 per year in U.S., its possessions and Canada; other countries $6 per year.

Copyright, 1971, Howard W. Sams & Co., Inc. All rights Reserved: Material may not be reproduced or photocopied in any form without written permission of publisher.

EDITORIAL
GEO. H. SEFEROVICH, Director
J. W. PHIPPS, Managing Editor
CARL BABCOKE, Technical Editor
BARBARA L. BORDERS, Editorial Assistant
DUDLEY ROSE, Art Director

CONTRIBUTING AUTHORS
Bruce Anderson
Joseph J. Carr

TECHNICAL CONSULTANT
JOE A. GROVES

EDITORIAL ADVISORY BOARD
LES NELSON, Chairman
Howard W. Sams & Co., Indianapolis

CIRCULATION
EVELYN ROGERS, Manager

ADVERTISING SALES
Kansas City, Missouri 64105
Tele: 913/888-4664
E. P. LANGAN, Director
R. JACK HANCOCK, Manager
JAKE STOCKWELL
JOAN HIRES, Production

REGIONAL ADVERTISING SALES OFFICES

Indianapolis, Indiana 46280
ROY HENRY
2469 E. 98th St.
Tele: 317/846-7026

New York, New York 10019
CHARLES C. HORNER
3 W. 57th St.
Tele: 212/688-6350

Los Angeles, California 90005
JOHN D. GILLIES
3600 Wilshire Blvd., Suite 1510
Tele: 213/383-1552

London W. C. 2, England
JOHN ASHCRAFT & CO.
12 Bear Street
Leicester Square
Tele: 930-0525

Amsterdam C. Holland
JOHN ASHCRAFT & CO.
W.J.M. Sanders, Mgr.
for Benelux & Germany
Herengracht 365
Tele: 020-240908

Tokyo, Japan
INTERNATIONAL MEDIA
REPRESENTATIVES LTD.
1, Shiba-Kotohiracho, Minatoku
Tele: 502-0656

ELECTRONIC SERVICING (with which is combined PF Reporter) is published monthly by Intertec Publishing Corp., 1014 Wyandotte Street, Kansas City, Missouri 64105.

Subscription Prices: 1 year—$5.00, 2 years—$8.00, 3 years—$10.00, in the U. S. A., its possessions and Canada.

All other foreign countries: 1 year—$6.00, 2 years—$10.00, 3 years—$13.00. Single copy 75¢; back copies $1.
Adjustment necessitated by subscription termination at single copy rate.

Robert E. Hertel, Publisher
Intertec Publishing Corp.
Subsidiary of Howard W. Sams & Co., Inc.

**SERVICE** technicians know that Color TV repair demands more time and effort. That's why Sprague strives to simplify Color TV capacitor selection.

**COLOR** TV capacitors by Sprague come in the _exact_ ratings required to meet the exacting requirements of Color TV.

**TV** service becomes more demanding as Color TV keeps expanding. That's why _exact_ capacitor ratings are important. They help you to restore original set performance.

**EASIER** selection of replacement capacitors for Color TV is assured when you look to the broad Sprague line. You'll get the capacitor you need—when you need it—every time.

*Just off the press!* See your Sprague Distributor for a free copy of our new 40-page K-110 Twist-Lok® and Print-Lok® Capacitor Replacement Manual, or write to: Sprague Products Company, 105 Marshall St., North Adams, Mass. 01247

6S-1101R1

SPRAGUE®
THE MARK OF RELIABILITY

***THE BROAD-LINE PRODUCER OF ELECTRONIC PARTS***

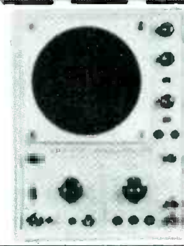
*Circle 5 on literature card*

# Leader INSTRUMENTS CORP.

## PREFERRED FOR QUALITY, ACCURACY AND ECONOMY BY SERVICE ENGINEERS AND TECHNICIANS, EVERYWHERE.

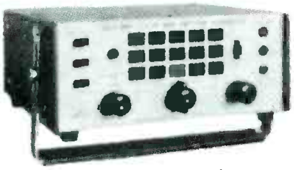
**LCG-384**

Mini-portable battery operated **Color Bar Generator.** Solid state with digital binary system. Uses four 1.5V cells; has 8 basic patterns; 2 push button selectable frequencies and temp. change protection. Accessories, carry case, batteries, incl. AC adaptable **$109.50**



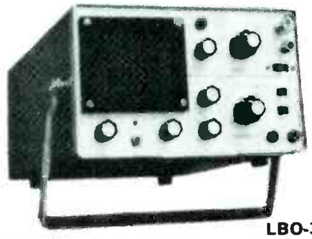
**LBO-501**

Our 5" Solid State **Triggered Scope** with calibrated vertical input and time base. Offers 20MVp-p/cm with a DC to 10MHz bandwidth. **Triggered** sweep range is from 0.2μsec/cm to 0.2sec/cm. Has lighted graticule, square wave calibration and tilt stand. Most important is the Lab Grade performance that signifies "Leader". **$339.50**



**LCG-388**

The ultimate in pattern stability thru digital accuracy — this **Color Bar Generator** features: Lab Grade performance, digital binary frequency divider, 15 patterns, two switch selectable channels; regulated DC power supply and ambient temp. comp. For in-shop or field use. Accessories incl. **$159.50**

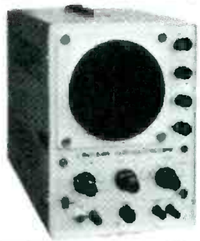


**LBO-301**

The only 3" **Portable Triggered Scope** available with vertical and horizontal calibration. Yes, it's solid state with unmatched sensitivity. Bandwidth is DC to 7MHz and there's a new, easy-to-use horizontal panel. Featured are 5X mag. and sweep time of 0.2μsec. to 50ms/DIV in fifteen ranges. A new Leader achievement, it's compact and reliable. **$334.50**

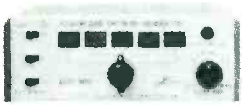
**LCG-389**

Economy and stability at home or away . . . here is a Leader **Color Bar Generator** that fits into any tube caddy and has our binary frequency divider. Operation is not affected by temp. change. Patterns include gated rainbow, dots, crosshatch, horiz. and vert. lines. Carry case and gun-killers incl. **$99.**



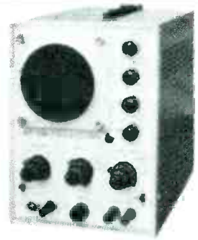
**LBO-54B**

Here's outstanding operational stability and sensitivity in a 5" **Oscilloscope/Vectorscope** with calibrated vertical input; 10MVp-p/cm sensitivity; DC to 10MHz bandwidth; plus high linearity sweep range and automatic synch. DC coupled with push-pull amplifiers for distortion-free displays. **$249.50**



**LCG-390**

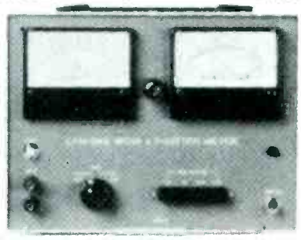
Dependability is the word for this **Color Bar Generator!** Complete with crystal-controlled oscillators, P.C. board construction and digital clock dividers. Patterns include gated rainbow; R-Y, B-Y and —(R-Y); dots, crosshatch and single cross. Fits into caddy and has built-in gun killer. Carry case incl. **$119.50**



**LBO-32B**

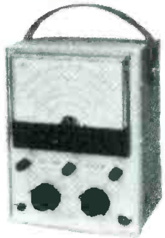
A handy, easy-to-use 3" **Wideband Scope** (7MHz) that is ideal for field and general use. Features FET input stages and DC coupled transistorized amplifiers — push-pull for low distortion. Has a special TV signal display sweep circuit position. Combines high performance with great economy. **$189.50**

## Seeing is Believing



**LFM-36A**

Measure **Wow, Flutter** and **drift,** simultaneously, with this solid state direct reading instrument. For tape recorders & other devices. Has separate meters for measuring each function. Accuracy is ±5% of full scale value. Signal frequency is 3KHz. Compact, rugged, for bench or assembly work. **$550.**

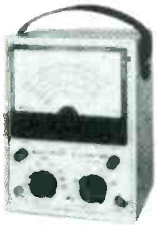


**LV-76B**

A highly stable, extremely sensitive **Vacuum Tube Voltmeter** with 11 megohm impedance for minimizing loading effects. The input, AC or DC, may be changed by switching rather than lead changing. The AC range is to 4MHz. One probe performs all measurements. **$59.50**

**LMV-87A**

Use this solid state **AC Millivolt Meter** for testing sensitive audio and video equipment. Measures AC voltages from 1MV to 300V over a wide range; checks for phono output, hum and noise of phono cartridges and tape heads. It's wideband preamplifier boosts scope sensitivity. Features 10MΩ input impedance. **$124.**



**LV-77**

This general purpose **FET Multimeter** is equipped with Field Effect Transistors for high impedance and solid state stability. Light and portable, it has an AC/DC power supply; easy-to-read scale and is packaged in a rugged, attractive functional case. Excellent for application everywhere. **$89.50**

*See your distributor.*

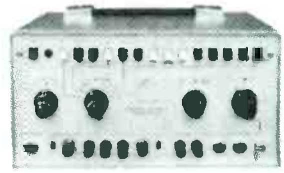
**Leader**
INSTRUMENTS CORP.
37 · 27 Twenty-Seventh Street,
Long Island City, N.Y. 11101 (212) 729-7410

# Leader INSTRUMENTS CORP.

## FROM SCOPES TO GENERATORS TO CRT CHECKERS AND REJUVENATORS... LEADER IS THE UNCHALLENGED FIRST.

LFC-943

A battery-powered **TV Field Strength Meter,** all solid state, and offering "hands-free" operation. Incorporates a precision decade attenuator, level indicator, and combination dB/MV scale; plus regulated battery DC voltage. Equipped with earphone for audible signal check. **$375.**

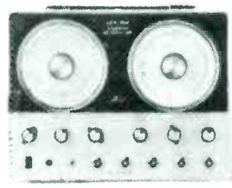


LSW-330

A highly accurate and ultra-stable post-injection **Sweep-Marker Generator** unmatched for color TV service. Provides all sweep and marker signals for chroma, video & sound IF, circuit alignment. Has two selectable RF channels plus automatic limit control for constant amplitude. 10.7MHz sweep extends use with FM-IF. Compact, lightweight. **$399.50**

LCT-902

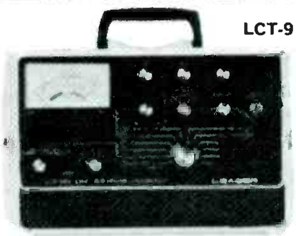
A battery-powered, in-circuit **Tracer/Checker** for transistor checking. Excellent for field work. Determines Beta and Iceo of transistors plus diode quality. Also functions as a signal tracer for RF and AF applications. Convenient DC voltage and current ranges add to its utility. **$99.50**



A new, solid state, **Sweep/Marker Generator** for testing TV and FM circuits in conjunction with any scope. Frequency range covers 2-260MHz, continuously adjustable with 0 to 20MHz, max. adjustable sweep width. Has highly accurate post-injection marking with provision for external signal input. Access. incl. **$299.50**

LSW-250

LCT-910



This **CRT Tester/Rejuvenator** offers a quick and reliable means of checking color and B&W without removing tube from the chassis. It has an easy-to-read meter scale, compares color gun emission and grid cut-off characteristics, and repairs shorts, opens and leakage between elements. Rejuvenates tubes to proper emission and brightness. **$129.50**

LSG-230

The **FM Multiplex Signal Generator** for quick, easy servicing of audio equipment. Generates RF and IF marker signals and composites. Tests FM balance and separation and is also a sweep marker for 10.7MHz FM and IF alignments. Continuously adjustable freq. range 75 to 110MHz; 3V output, approx. **$175.**

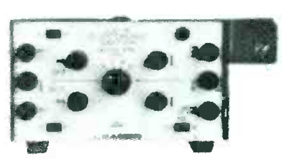
LHM-80

Measure up to 30KV with this **CRT Test Probe.** Never needs batteries, warm-up or external power. With built-in voltmeter safety divider and high impact molded body. Has 20,000Ω/V sensitivity and a full scale accuracy of ±3%. Ground wire and heavy duty field clip included. **$19.95**

## Instruments to Believe In

LDM-810

Determine resonant frequency of LC networks in TV and radio circuits with this useful **Grid Dip Meter.** Equipped with 6 coils to cover 2-250MHz range and a modulation monitoring earphone. AC operative; use for aligning receivers, adjusting wave traps, and finding parasitic oscillations. **$44.50**



LS-5

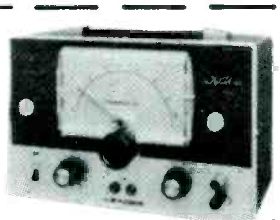
A **Solid State Electronic Switch** to extend use of any single trace scope to dual trace. Compares voltages, waveforms, amplitudes, etc. Has "instant-on" and triggers scope for fast and stable synch. Special built-on mounting bracket for any scope. Offers 4 switching frequencies, 2 channel inputs and freq. resp. is DC to 300KHz; 2Hz to 200KHz in AC. **$69.95**

LSG-15

A solid state **Wideband, RF Signal Generator,** for all around use. Features accurately calibrated frequency dial plus FET's. Has an internal 400Hz modulation source; 120KHz to 130MHz; to 390MHz on harmonics. Functions as a marker-generator for checking RF and IF stages in TV and FM receivers. Accessories incl. **$79.50**

LDC-820

A compact, 4 digit **Display Frequency Counter** for use to 12.5MHz. Automatic trigger level control assures input signal stability and noise immunity. An optional plug-in unit to extend the LDC-820 to 5 digit display is also available. With accessories.



LAG-25

All new, solid state **Sine/Square Wave Generator,** 20-Hz to 200KHz range in four decades. Has low distortion sine wave and fast rise square wave for testing sensitive audio equipment. Generates a complex wave output for I-M checks and can synchronize frequency from external source. **$99.50**

*See your distributor.*

Leader
INSTRUMENTS CORP.
37 - 27 Twenty-Seventh Street,
Long Island City, N.Y. 11101 (212) 729-7410

*Circle 6 on literature card*

# electronicscanner

*news of the industry*

### Women In TV Servicing Form Nationwide Club

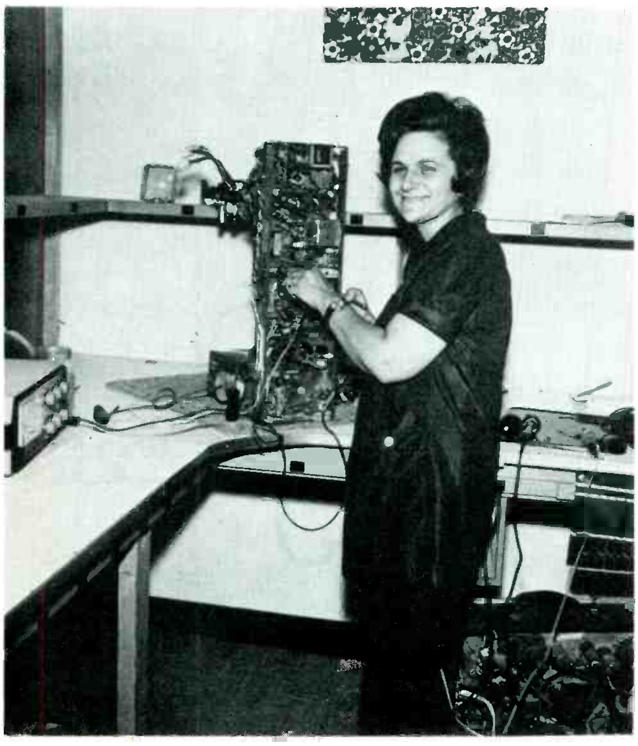
A new, nationwide club exclusively for women engaged in professional electronic servicing has been formed. Called LITES—Ladies in Technical Electronic Servicing—the unique professional organization was founded by Mrs. Sandra Schaffner, who works with her husband, Len Schaffner, a TV service technician, at his servicing firm, Country Club Electronic Service in Simi Valley, California. Country Club Electronics is the only factory authorized Magnavox service center in the area. The couple also manage Kings Magnavox Home Entertainment Center in Simi Valley.

According to Mrs. Schaffner, the purpose of the club is two-fold. It is designed to encourage more women to enter the field of consumer electronics repair and also is intended to serve as a forum to exchange ideas and technical developments for women already in the TV repair field.

All the club members will be invited to convene once a year on a national basis and to have several regional meetings each year. In addition, a newsletter providing for an exchange of information will be issued on a regular basis.

Mrs. Schaffner stated that while the number of women professionally employed in consumer electronic servicing now is relatively small, the vocational opportunity is enormous.

"There is not only a tremendous shortage of qualified consumer electronic repair personnel today, but the field is highly compatible for women's capabilities," said Mrs. Schaffner. "Not only is it a wide-open career field for interested women, but the natural feminine concern for small intricate detail and for wanting everything working properly in its place makes electronic repair a natural vocation for women."



Those wishing further information on LITES should contact Mrs. Schaffner, Kings Magnavox, 1209 Los Angeles Avenue, Simi Valley, California.

### CSEA Requests Assistance To Defeat Proposed "Consumer" Bill

The California State Electronics Association (CSEA) has asked for assistance from the National Electronic Associations, Inc., (NEA) and from other industry elements, in defeating a proposed California bill (AB 2231) which amends section 9841 of the Business and Professional Code, and makes additions to the Civil and Vehicle Code of that state.

Bill AB 2231 enacts "California consumer fair repair warranty act", which reportedly imposes warranty duties on persons who provide certain repair or improvement services to a consumer for compensation. The bill reportedly further requires specific notice of consumer's rights be given before commencement of repairs.

The Bill reportedly is opposed by CSEA because of a loophole which reportedly allows a customer to retain the **required** 30-day repair guarantee, perpetually, by merely making a complaint near the end of each guarantee period.

AB 2231 also requires that the entire product serviced, including parts and labor, be guaranteed. It reportedly automatically assumes the repair dealer is guilty until proven innocent, and does not allow for "limited repairs" such as customers often desire, especially on older equipment.

NEA asks that all industry elements affected by the bill take appropriate action to inform lawmakers in the California legislature, 1971 regular session, of the detrimental effects AB 2231 might have. The bill is currently under consideration in the Judiciary committee.

### Legislator Tells Independent Business To "Get Involved In The Tax-Writing Process . . ."

Senator Alan Bible, Nevada, Chairman of the Senate Small Business Committee, urges the nation's independent business people to pay more attention to the tax-writing process, saying, "get involved in the tax-writing process or be squeezed out by default."

"There is persuasive evidence that small businessmen have not made their case to tax-writing authorities," Bible says. He cites what he calls "substantial setbacks" in the 1969 Tax Reform Act and "even worse prospects for small business firms in a list of Administration proposals."

Bible notes the Administration's tax depreciation proposals of last January 11 would provide 55 percent of its benefits to the nation's 103 largest corporations and 80 percent to the largest 2,500 "with small busi-

*(Continued on page 8)*

the new
# Finco®
# Greenline

## HOME TV/FM MULTIPLE SET AMPLIFIERS

***Amplifies TV/FM signals for distribution to every set in the house!***

Solid state design meets the most demanding reception conditions
Five different models for every reception requirement.

**SAFE! DEPENDABLE! INEXPENSIVE!**
**FOR COLOR TV . . . BLACK & WHITE TV . . .**
**FM/FM STEREO**

**G-922**

300 ohm system, VHF-UHF-FM, 300 ohm input and four 300 ohm outputs using twin lead wire.
**List $43.95**

**G-923**

75 ohm system VHF-UHF-FM, 75 ohm input and four 75 ohm outputs using coaxial cable.
**List $46.95**

**G-924**

75 ohm system, VHF-UHF-FM, 75 ohm input and single 75 ohm output using coaxial cable.
**List $45.95**

**G-920**

300 ohm system, VHF-FM only, 300 ohm input and four 300 ohm outputs using twin lead wire.
**List $33.95**

**G-921**

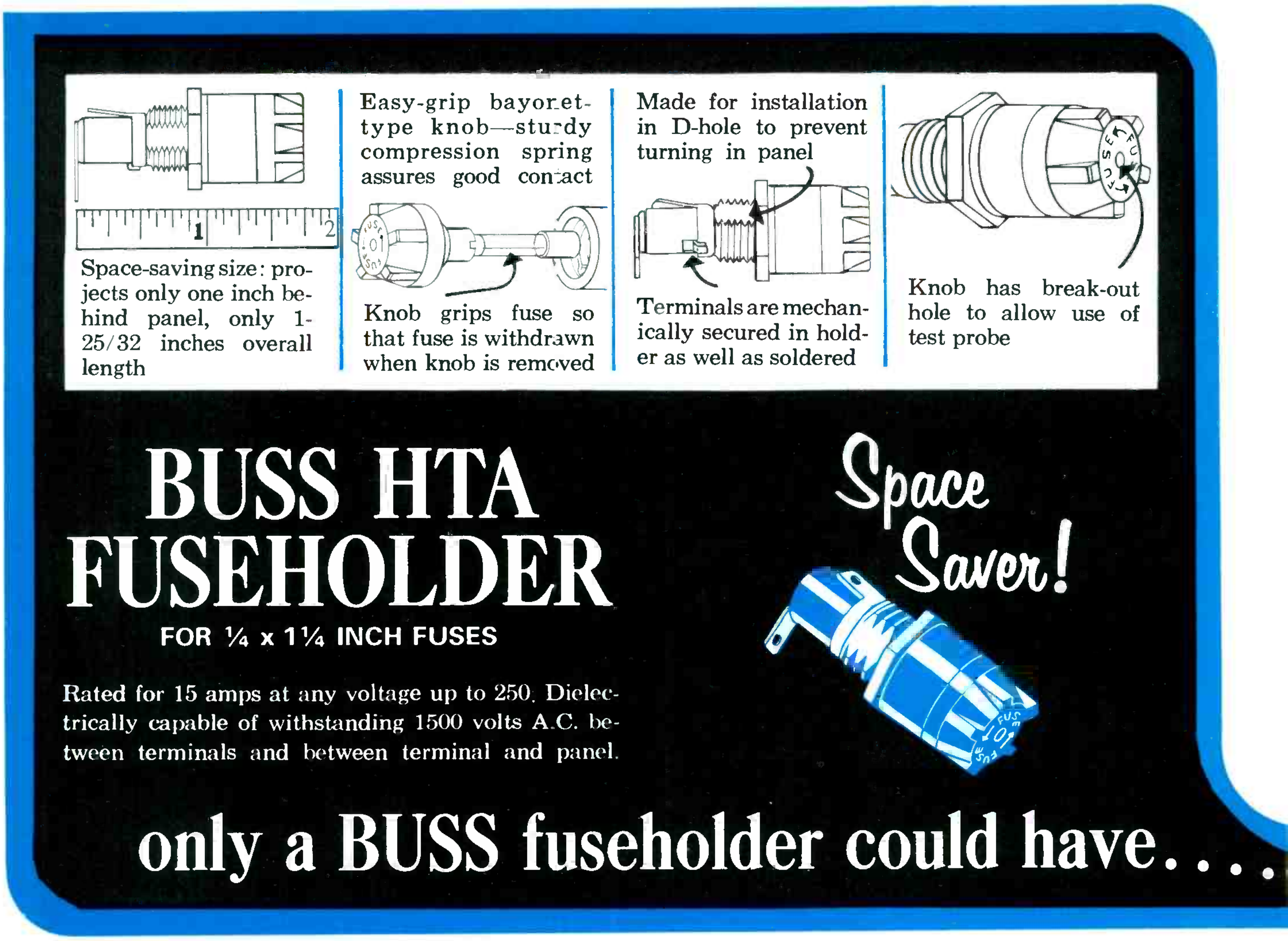
75 ohm system, VHF-FM only, both 75 ohm and 300 ohm inputs and four 75 ohm outputs using coaxial cable.
**List $39.95**

WRITE DEPT. 310-8 FOR CATALOG NO. 20-594.

**FINCO MATV**

**THE FINNEY COMPANY**
**34 W. Interstate Street**
**Bedford, Ohio 44146**

*Circle 7 on literature card*




*(Continued from page 6)*

ness, representing 99 percent of all business, left with the inequitable balance."

Outlining the complexities and imbalances to small firms which reportedly "have crept into the tax system," Bible urges businessmen to place their views before their Representatives and Senators in their home districts or risk continued "taxation without representation."

Bible is co-author of a small business tax bill with Congressman Joe Evins, Tennessee, Chairman of the House Small Business Committee.

"I feel there is a strong claim for inquiring into the field of business taxation from the viewpoint of the great majority of smaller and less-advantaged American firms," Bible says. "The country is not accustomed to examining our tax system in fundamental terms. Yet the government must come to grips with these deeper economic issues if we are to provide room at the bottom for new and growing small enterprise and a climate of profitability and continued independence for those now in existence."

### Average Annual Pay of Service Workers in 1960's Increased at Slower Pace Than That of White- and Blue-Collar Workers

The average annual wage increases of individuals employed in service-type occupations in the 1960's were substantially less than those of white- and blue-collar workers, according to a report of a recent Bureau of Labor Statistics survey of the income of the heads of families in non-farm jobs, published in the **Wall Street Journal.**

Average annual increases for service workers was 1.9 percent, while those for white- and blue-collar workers were 2.8 and 2.2 percent, respectively.

The report noted that the difference between the pay of white- and blue-collar workers is widening in favor of the white-collar workers.

Pay data for the 1960's might indicate a reversal of the trends of the two previous decades, during which the pay of blue-collar workers increased faster than that of white-collar types, according to bureau analysts.

The median annual income of white-collar workers in 1969 was $10,446; that of blue-collar workers was $8,094.

Median income of the wives of white-collar workers reportedly also increased faster during the 1960's than did that of the wives of blue-collar workers.

### FCC Tells Lawmakers About Forthcoming Cable TV Rules

"We want to open the way for cable to bring needed television to underserved areas, to improve reception, and to make possible greater diversity of television."

This statement by Federal Communication Commission (FCC) chairman Dean Burch, made in June to a Senate Commerce subcommittee, is a "consensus" of the FCC commissioner's attitudes about forthcoming rules on regulating community antenna television (CATV) systems, according to a recent report in **Home Furnishings Daily.**

The FCC chairman reportedly also commented that "one of our (the FCC's) main purposes in allowing cable to develop is to provide the means for new and diverse services unique to cable".

Chairman Burch reportedly told the legislators that the commission is considering: 1) letting local cable systems in smaller markets carry all local signals and distant signals required to make up a complement of three networks and one independent; 2) establishment of a three-network/three-independent station service plus two additional signals for top 50 markets; and 3) a three-network/two-independent station service plus two additional signals for top 51-100 markets.

Included in the "diverse services" the FCC reportedly has in mind for CATV are two-way communication, "new services to homes and schools" and two-way, non-voice communication, such as a button on TV which would enable individuals to participate in surveys, marketing services, and even burglar alarm systems.

The FCC, according to the report, also proposes that cable systems in the top 100 markets provide a non-broadcast channel for each broadcast channel carried.

### California Branch of Precision Moves To Sacramento

The California branch of Precision Tuner Service has moved to larger facilities in Sacramento from their previous location in Turlock, according to Roland F. Nobis, president of Precision. The new address is 4611 Auburn Blvd., Sacramento, Calif.

### Speeded-Up Equipment Write-Off Program Reportedly Adopted By U.S. Treasury

The U.S. Treasury department reportedly has adopted regulation revisions which will permit business to write off the cost of new equipment up to 20 percent faster than at present.

The new program, called "asset depreciation rate system" (ADR), reportedly has already come under fire from consumerism advocates, who have questioned the Treasury's authority to make such changes administratively.

### Sylvania Names Distributor In Jackson, Miss.

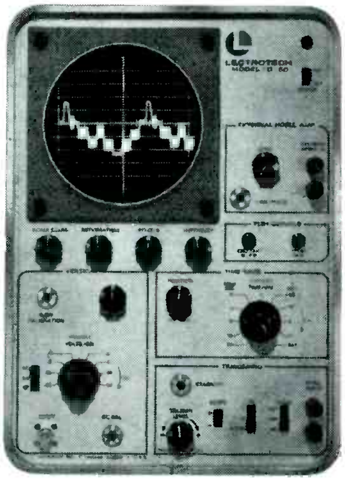
The Stuart C. Irby Company, 815 S. State St., Jackson, Miss., has been named a franchised distributor for the Electronic Components Group of Sylvania.

The new distributor will handle Sylvania's lines of color and monochrome television picture tubes, receiving tubes, replacement semiconductors, and special products. ▲

TRUE TRIGGERED SWEEP
OSCILLOSCOPE/VECTORSCOPE

MODEL TO-50

- DC to 10 mhz frequency response
- .02 volt sensitivity
- Calibrated vertical attenuator
- Calibrated time base
- Supplied with combination direct/locap probe
- 5 X magnifier
- Automatic triggering mode
- 5" flat face tube edge-lit graticule



One Year Warranty
All American Made
$339.50 NET

See your distributor or write Dept. E-4
LECTROTECH, INC.
4529 N. Kedzie Ave., Chicago, Illinois 60625

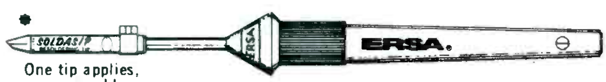
*Circle 9 on literature card*

SOLDERING +
DESOLDERING +
RESOLDERING =
SOLDER ABILITY
ELEMENTARY TO ELITE
WORLD'S MOST PRACTICAL SOLDER HANDLING TOOLS

SOLDAPULLT® • SOLDAVAC™
Desoldering Tools

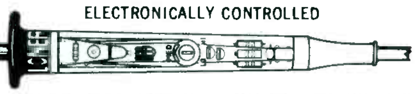
● LIGHT WEIGHT, PORTABLE ● SELF-CLEANING ● FAST, VACUUM ACTION

SOLDASIP™ RESOLDERING TIPS
ERSA® SOLDERING TOOLS



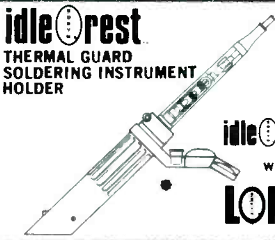
One tip applies, removes solder
● EXPERT CRAFTSMANSHIP ● FAST SOLDERING CYCLES

LONER SOLDERING INSTRUMENT
IN A CLASS BY ITSELF FOR YOU ALONE
ELECTRONICALLY CONTROLLED
EASY KNOB CONTROL
TEMPERATURE SETTING



Send for our FREE 12 page SOLDER ABILITY manual.
EDSYN
15954 ARMINTA STREET
VAN NUYS, CALIFORNIA 91406
PHONE (213) 989-2324
TELEX NO. 65-1469 EDSYNEX VAN

idle rest
THERMAL GUARD SOLDERING INSTRUMENT HOLDER



idle rest with LONER

* U.S. and Foreign Patents Applied For
Ads in EEM, MAS, EBG, AE, TR, and EPAC Catalogs

*Circle 10 on literature card*

# readers exchange

■ Electronic technicians and owners or managers of electronic service shops who need assistance obtaining a part, service literature or any other item related to the servicing of electronic equipment are invited to use this column to inform other readers of their need. Requests submitted for publication in this column should be sent to: Readers' Exchange, ELECTRONIC SERVICING, 1014 Wyandotte St., Kansas City, Mo. 64105. Include a brief but complete description of the item(s) you need, your complete mailing address and how much you are willing to pay for the item(s). Individuals responding to a request in this column should write **direct** to the requestee.

### Help Needed

*I have read an occasional letter in ELECTRONIC SERVICING seeking a source of supply for old-fashioned spring-wound phonograph parts. Readers can obtain any part they need from A. J. Nugent, 3804 Charles City Road, Richmond, Va. He has a large stock of old phonograph parts, and what he doesn't have he can make for you.*

*B. J. Brown*
*Box 548*
*Trion, Ga. 30753*

*I am in need of a service manual for a Jackson Tube Tester, Model 648. If I can get a chart listing for (complete) tubes, that would be better. Please forward charges for the above.*

*James Jimenez*
*11526 Rochester Ave.*
*Los Angeles, Calif. 90025*

*I need a CRT printed board, part No. 32-11576-2 for a Sylvania color set, Model 25LC10M. This board is only about three years old and it is no longer available from the Sylvania Parts Center in Melrose Park, Ill.*

*If any Sylvania dealers have this part available, I would be glad to hear from them.*

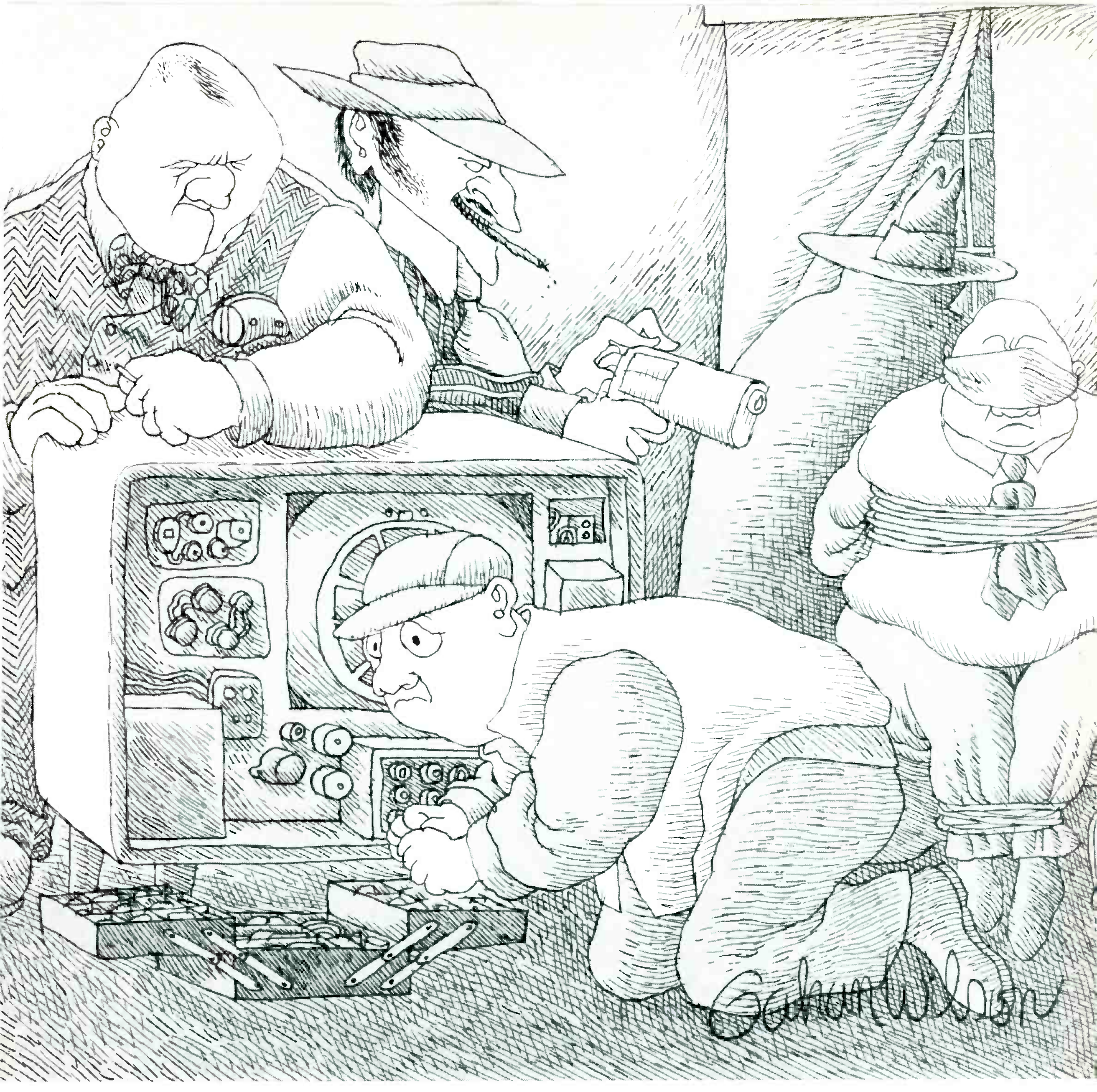
*J. Saylor*
*A to Z Electronics*
*RFD #2 Box 324*
*Thurmont, Md. 21788*

*I need a schematic or a source of information for a Heath Model AA-15. I will gladly pay for schematic.*

*Severo Rosa*
*Quina St. NB-49*
*Bayamon, Puerto Rico 00619*

*I need help in locating the following parts for repairs to Webcor Tape Recorders. I understand from*

*(Continued on page 12)*



# When you're in a hurry, it's nice to know Sylvania has the parts.

**Only 34 tubes and ECG solid-state components will solve practically all of your high-voltage rectifier replacement problems.**

And they're all available from your Sylvania distributor.

Because tubes are tubes, we can't promise to reduce the number you'll have to carry. But, with the Sylvania line, your distributor will have the tube you need when you need it.

In semiconductors, the story is different. Just 124 ECG solid-state devices including transistors, diodes and integrated circuits will replace over 41,000 different types. In the high-voltage section alone, only 8 ECG rectifiers and triplers will take care of almost every job.

And they save a lot of space in your tube caddy.

When your distributor is stocked with Sylvania receiving tubes and ECG semiconductors you'll have the parts you need. And you'll get them fast.

It's like having a complete warehouse built into your telephone.

And that should help you make a fast getaway.

**GTE SYLVANIA**

*Circle 11 on literature card*

# NEW... for ES readers only!

**CLASSIFIED ADVERTISING**

Beginning in the July issue of ES, a classified ad section, titled "The Marketplace", will be made 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. (July inserts must be received by June 1).

**Send insertions with full payment to:**

**Electronic Servicing**
Classified Advertising
1014 Wyandotte Street
Kansas City, Mo. 64105

(The Classified Section is not open to the regular paid product advertising of manufacturers. Classified advertising is intended as a service to technicians and shop owners or managers seeking employment or recruiting employees or who wish to dispose of surplus supplies and equipment.)


*the Consolidated Merchandising Co. that these parts are no longer stocked. The parts needed are:*

*Model ED 2250-1; tape counter, drive belt, counter; reel spindle assembly, left; head cover, switch assembly, switch arm, "C" ring.*

*Model EP 2208-1; tape counter, head cover, stop push button.*

*Anyone able to furnish these parts from shelf stock, or from old tape recorders from which parts could be salvaged, kindly contact me stating condition and price. If parts are to be salvaged from old recorders, I am willing to purchase the individual parts, or the complete recorder.*

*Donald P. Bouchereau*
*310 Chetimaches St.*
*Donaldsonville, La. 70346*

*I need information for locating a horizontal output transformer for a Motorola chassis BP902A-01 (19-inch CRT). Transformer number is 24D734487.*

*John H. Faulstich*
*172 Prospect St.*
*Belvedere, N.J.*

*I need the schematic diagram for an 11-tube AM/FM/FM stereo, phono, TV amplifier. The only markings are: Olympic CL2871975B6AE3280 (this is located on the tuner); and Run 522 and 5469 (this is located on the chassis). The AM antenna reads LP29257 CB.*

*Any information will be greatly appreciated.*

*Michael LeGrande*
*3401 38th Ave.*
*Long Island City, N.Y. 11101*

*I need the following test equipment: 1) color test jig; 2) color-bar generator; 3) sweep/marker generator. Test equipment must be in excellent condition.*

*G. C. Pullen*
*6722 Botetourt Dr.*
*Oxon Hill, Md. 20022*

*I need help in finding parts for a Soundex, Model No. SA18 car radio. The date on the radio is Jan. 4, 1961. I need Sprague parts RC2 and RC3. I wrote directly to Sprague and they do not have these as repacement parts.*

*I would appreciate any information on where I might get these parts or where I could get a schematic of the radio.*

*Joel J. Avery*
*1935th Comm. Sq.*
*Box 5087*
*APO Seattle, Wash. 98728*

*I have an old Dumont Model 274 oscillograph, Serial number 3962, for which I need a schematic or an operator's instruction manual. Will gladly pay a reasonable cost for either or both.*

*Edward Fox*
*12 East Brown St.*
*Knightstown, Ind. 46148*

*(Continued on page 14)*

There's a special way you can meet customers without lifting a finger. The Yellow Pages! The Yellow Pages is every town's complete shoppers service.

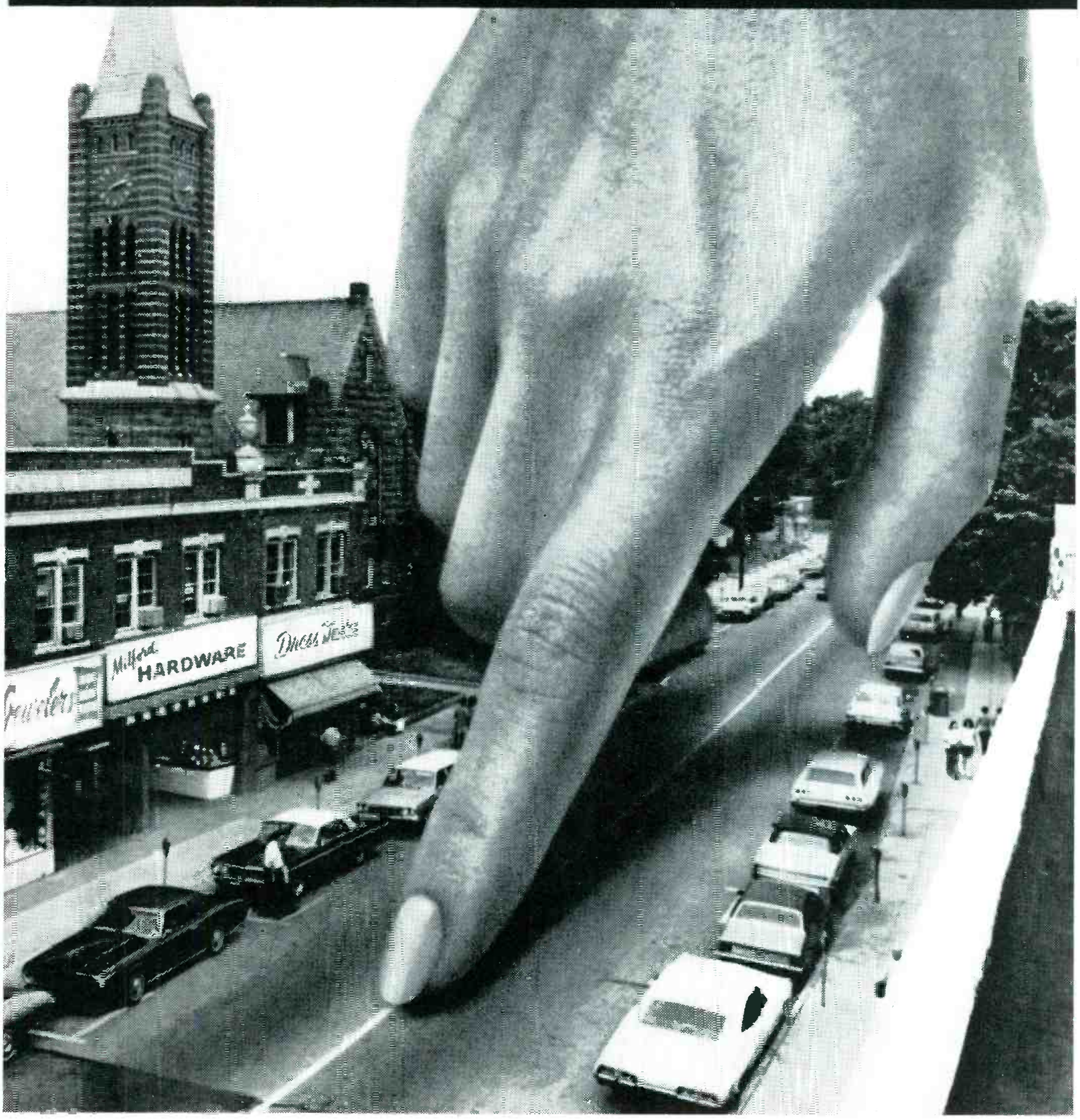
How can you best take advantage of the Yellow Pages? Ask your Yellow Pages representative to help you prepare ads for any or all Yellow Pages telephone directories coast to coast.

Remember, 3 out of 4 potential customers let their fingers do the walking. Advertise in the Yellow Pages.

**We'll put you at your customers' fingertips.**

3 out of 4 prospects let their fingers do the walking.

Yellow Pages

**Put it to Work!**

**NEW AND ONLY FROM EICO- THE INDUSTRY'S LOWEST-PRICED PROFESSIONAL FET-TVM.**

**Model 239**

**KIT $39.95**

Use the battery powered Solid State EICO 239 on your bench or in the field. Check semiconductor and vacuum tube circuits. 11 Megohm DC input impedance. Read AC rms and DC voltages in seven steps from 1 to 1000 volts on large 4½" meter. Measure and read peak-to-peak AC to 2800 volts. Check resistance from 0.2Ω to 1000MΩ on seven ranges. Provides a total of 28 useful ranges on 12 accurate scales. Automatic battery check. Includes exclusive DC/AC ohms Uniprobe™. Factory Assembled, $59.95.

**FREE 32 PAGE EICO CATALOG**

For latest catalog on EICO Test Instruments, Stereo, EICOCRAFT Projects, Environmental Lighting, Burglar/Fire Alarm Systems, and name of nearest EICO Distributor, check Reader Service Card.

EICO, 283 Malta Street, Brooklyn, N.Y. 11207 EICO

*Circle 14 on literature card*


*I am an electronics student and need the following back issues of PF REPORTER:*

*1961–July, Aug., Sept., Oct., Nov.*
*1962–Apr., May, Aug., Sept., Nov., Dec.*
*1963–Jan., Feb., Mar., Apr., May, June, July, Aug., Oct., Nov., Dec.*
*1964–Jan., Feb., May, June, Aug., Oct., Nov.*
*1965–Jan., Mar., Apr., May, July, Aug., Sept., Oct., Nov.*

*I would also like to purchase books about color and transistor TV servicing, color-bar generators, high-voltage probes, a book on the 8YP4 CRT, and Supreme TV Manuals Nos. 26 and up.*

*I will pay educational rate postage or reasonable fee. Please write before sending material.*

*M. Valer*
*4624 N. Marvine St.*
*Philadelphia, Pa. 19140*

*I need a schematic diagram for a National Radio, Model 183-D. I will be willing to pay for a copy of this schematic.*

*Edwin Padilla*
*P.O. Box 2453*
*San Juan, Puerto Rico 00903*

*I need the instruction manual or a copy of same for a Precision Model E400, sweep signal generator and a Philco Model 7008 visual alignment generator and scope. Will gladly pay for information.*

*Robert Evans*
*768 West Union St.*
*Jacksonville, Fla. 32202*

*I need the manual for a Genescope, Model LGO-600, manufactured by Ohmatsu Electric Co., Ltd. I would also like to know the cost of a unit like this brand new.*

*Peter Starropulos*
*Branger 91-37*
*Valencia, Venezuela*

*I need the schematic diagram and an up-to-date tube chart for a Seco, Model 107 mutual conductance tube tester. I would also like to know if this company is still in business.*

*R. K. Anderson*
*2639 W. Philadelphia*
*Detroit, Mich.*

*I need a source of service information and parts for a Dumont two-way radio. Any help will be appreciated.*

*Cletus A. Hunt*
*R.D.#1*
*York, Pa. 17404*

*I am looking for a schematic diagram for a Dumont, Model 101-B low-band VHF transceiver. I will be glad to pay for schematic.*

*Bertram Marsden*
*200 North Liberty*
*Jerseyville, Ill. 62052*

▲

# letters to the editor

### Ethical Business Practices—Moral, Legal or Both?

*I have decided to discontinue my TV and Radio servicing business for several reasons, most of which involve what I consider to be unethical practices by my competition.*

*For example, several times when a part has not been immediately available from local parts distributors and customers have been unwilling to wait for parts, another service shop, which had the parts in stock, charged me the full list price plus 10 percent. This usually involved rarely needed parts.*

*I have always tried to conduct my business in an ethical manner. For instance, over a short period I was called by several irate customers of another shop who complained that the shop had started the repairs of their sets but had not completed them because parts were not available. Once I determined that their problems were caused by unavailability of parts, I refused to service their sets, because the jobs were started by the other shop and, in my opinion, rightfully belonged to that shop.*

*It seems to me that the manufacturers are taking over the servicing business, and eventually there will be no independent technicians. In my opinion, this is why the manufacturers seemingly are not interested in making parts available within a reasonable time to independent technicians.*

*In my opinion, proper business ethics dictate that a technician who has a part for which he has no immediate need should make that part available at cost to other technicians who have an immediate need for it.*

*I also believe that service shops should compete only on the quality of service and the nature of the technicians. The customer then can choose the technician whom he thinks is best.*

*I have leased all my equipment and will eventually sell it.*

*Billie W. Fowler*
*Memphis, Tex. 79245*

There has been and probably always will be lengthy debate about what are and are not ethical business practices.

Some base their definitions on the age-old concepts of what constitutes moral behavior between men. These individuals usually maintain that the noble actions and restraints demanded by the Ten Commandments also apply to business activities.

Other individuals maintain that the name of the game is profit, and the only restraints which should be imposed are federal, state and municipal laws.

A third group, and probably the most successful, believes that a compromise position between the two extremes is the most realistic—and, in the long run, the most self-satisfying. Although they recognize that their business practices must be weighed in favor of profit and growth, they also realize that men, even those who are direct competitors, must live together. Consequently, if they can do it without jeopardizing an unreasonable amount of profit, they temper their business practices to account for the needs of other men.

The reasoning of this latter group usually is: Is a sacrifice of profit involved, and, if so, can I afford it?

If your former competitor is one of this latter group, he obviously has decided that he cannot accept the loss of 1) the return on the money he had invested in the parts he stocks, and 2) the amount that it costs him to maintain that particular part in his inventory.

Your act of not "taking advantage" of a competitor who, like you, could not obtain parts, is admirable, but, considering the competitive situation in your locality, was the sacrifice one you could afford or accept? Also, did it really serve the interest of the people of your community?—Ed.

### NATESA Leader Proposes Changes Which He Believes Will Contribute To More Efficient Problem Solving

*Recent events indicate a serious lack of participation in solutions of problems by individual service business operators. This is best indicated by the small number of surveys on the parts situation, despite the fact that all three service nationals and at least one major publisher, had been pleading for participation. As a result, at the last National Service Conference, an erroneous conclusion was announced.*

*All service leaders are fully aware that a serious and growing problem exists in procuring parts for most sets in most areas. This applies to domestic, and to a greater degree, to imports. Several major causes are responsible. Proliferation of models and types increases greatly the range of parts needed. To reduce costs, there is a big move by factories to setting up a very few distribution centers on which large areas must draw. This automatically causes a minimum delay of 2 days on many parts, including those long considered "staples".*

*To solve this and other service problems, and to avoid erroneous conclusions, it requires essential grass-roots participation by a vast majority of service business operators. These people are daily being swamped by extra duties caused by man-power shortages, additional paper work (in many cases brought on by governmental and factory demands), need for devoting more time to refreshers on new products, etc. In turn this causes them to bypass such vital needs as keeping their associations informed on their personal needs and thoughts, and ever greater delegation of policy making to leaders without the compensating factor of keeping them informed.*

*An example of this is the sudden proliferation of meetings in various phases of our industry, to the point that it is impossible to schedule a meeting without serious conflict with other important affairs. In the service industry we now have the National Service Conference (NSC), the Intra-Industry Steering Committee, and Electronic Industry Council (EIC) as major functions. Recent meetings reveal a great overlapping of functions.*

*To eliminate wasteful overlapping, mutiplicity of meetings at the national level, and to get the needed grass-roots participation that makes association actions meaningful, I propose that the functions of the National Service Conference be returned to the local level. Open meetings of all services in all areas should be conducted by the local association and area parts and set distributors where such exist, and by a consortium of parts and set wholesalers in other areas. Parts availability and other problems of direct interest of independent servicers should be discussed fully and openly and the consensus should be passed on to the Intra-Industry Steering Committee for consideration and direction. This group, comprised of representatives of all three service groups, has the experience, contacts and capacity to quite quickly solve a great many problems when they have facts to go on.*

*In those cases where the problem profoundly effects other phases, it would be referred to the Electronic Industry Council for consideration and solution.*

*This 3-step plan would generate greater participation, eliminate duplication of efforts, reduce need for costly and time consuming meetings, and expedite solutions. No longer would leaders be faced with trying to properly identify a problem and seek solutions on the basis of a handful of reactions.*

*NATESA-Chicagoland will, within 45 days, hold a mass open meeting, with invitations to all service people and distributors. The main subject will be specific service problems, such as parts availability and serviceability. The mass reaction summary will be passed on to the Intra-Industry Steering Committee for disposal.*

*Frank J. Moch*
*Executive Director*
*National Alliance of Television & Electronic Service Association (NATESA)* ▲

**Change of Address**

To receive Electronic Servicing at your new address, send an address label from a recent issue and your new address to:

**Electronic Servicing,** Circulation Dept.
1014 Wyandotte St., Kansas City, Mo. 64105

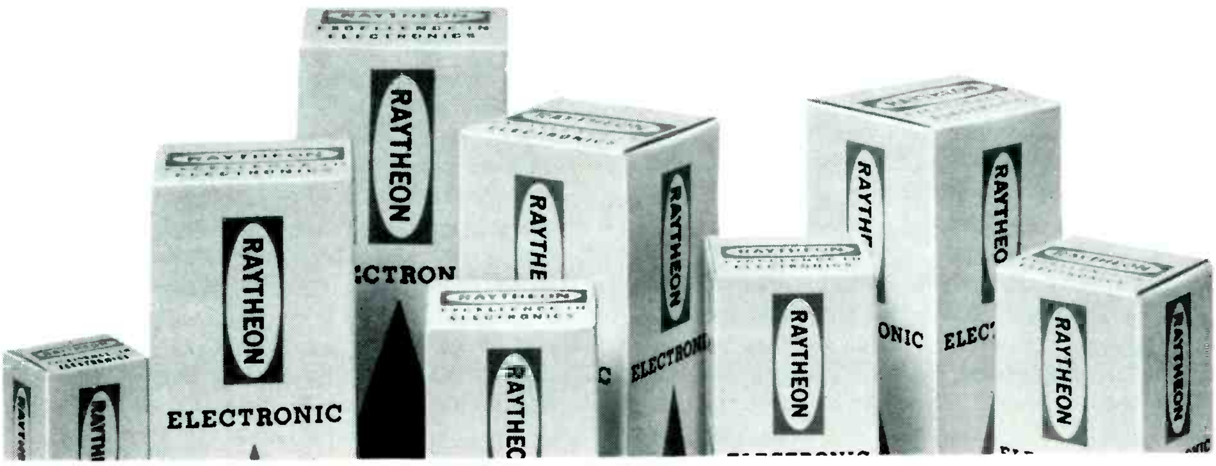
**If its about servicing consumer electronic products, you'll find it in ELECTRONIC SERVICING**


# Without you, we don't go anywhere.

You're independent, and so are we. No service trucks, no captive business. The only market for our tubes is you – the independent serviceman.

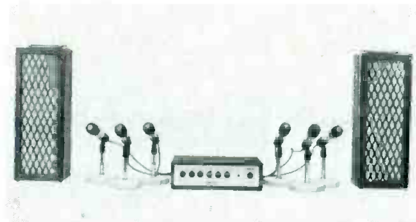
We're the largest independent tube supplier in the business. But you did that for us. You've learned you can depend on us. Because we depend on you.

Cooperation, not competition. Together, this has been our key to success in the past. Let's keep it that way.




*Circle 15 on literature card*

# audio systems report



## Solid-State Amplifiers

A new series of four solid-state public-address amplifiers, reportedly designed for reliability with all-silicon, solid-state circuitry, has been announced by the Bogen Div. of Lear Siegler, Inc.

The models in the "C" series are the C20, C35, C60, and the C100, rated at 20, 35, 60, and 100 watts, respectively. All are reportedly designed for operation at full output from –20 degrees C (–4 degrees F) to +50 degrees C (+122 degrees F). Each control has red Memory Markers to aid in returning controls to previously determined levels.

Model C20 (the smallest amplifier) has one high-impedance microphone input, with a volume control and two high-impedance, high-level auxiliary inputs with fader control, a tone control, and a power switch.

Models C35, C60, and C100 have identical features except for power ratings, according to the manufacturer. They have two high-impedance, high-level auxiliary inputs with fader control, master volume control, bass and treble controls, and a power switch.

All microphone inputs in the "C" series are equipped with filters to guard against radio frequency interference.

The list price for the "C" series is: C20, $132.50; C35, $162.50; C60, $197.50; C100, $247.50.

*Circle 40 on literature card*

## Soundette Mixer-Amplifier

The Soundette Model 6MA Mixer/Amplifier, a product of Sound-Craft Systems, Inc. is a PA system suited for "panel type" open meetings and similar applications.

Model 6MA reportedly accepts from one to as many as six microphones, or a combination of mikes, tape recorders, phono preamplifiers and tuners. Additional mixers are used in conjunction with the unit to increase channel capabilities.

The push-pull controls on all channels reportedly permit a meeting's moderator or PA operator to cut in or out separately mikes or other channels, without changing preset volumes.

The Model 6MA operates from standard 115-volt AC current and sells for $132.00. ▲

*Circle 41 on literature card*

**For more information about above products use reader service card**


# Two new B&K digitals that don't stand a chance of a ghost.

Ghosts, blurs, wiggles, jitters . . . whatever you call them, you won't get them with our two new digital color generators. You can converge, install or trouble-shoot color TV's quickly and accurately. Because these two units employ totally new concepts that take the trouble out of trouble-shooting.

Integrated circuit flip-flops perform all binary counting functions. Just no way they can jump a count. Result: Crisp, clean, stable test patterns.

And all IC's (nine of them) and transistors are silicon devices, which means they can withstand severe weather changes with no effect on performance.

The 1243 is a basic 6 pattern color generator. The deluxe 1246 has nine patterns, three more than the 1243, and also features a 4½ MHz sound carrier, crystal controlled RF for channels 3 and 4, gun killers, and comes with its own instant-use case.

All the accuracy and reliability of a computer in these compact units, and they're guaranteed to be maintenance free, making your job a lot easier.

So don't get a CBG that may come back to haunt you. Get one of B&K's new digital generators: They don't have a chance of a ghost.

B&K
Products of DYNASCAN CORPORATION
1801 W. Belle Plaine
Chicago, Illinois 60613
The new standard of stability

(Ask your distributor or write us for complete catalog)


1. B&K Model 1246 Color Generator **$149.95**

2. B&K Model 1243 Color Generator **$99.95**

*Circle 17 on literature card*

Better Management Guides

# Ratio Analysis: Your Measurement of Business Success

Comparing various indicators of your business with those of others will help you determine whether your operation is "normal", and if not, why.

by Robert G. Amick

### Why Ratio Analysis?

Last month we made the point that your books begin to tell the story when you gain **comparative** data—data about your business during two successive accounting periods, or two successive years.

Comparisons of the Operating Statements or Balance Sheets of those two periods will give you an idea of what gains you've made, or what the patterns and trends of your business growth are.

Month-to-month comparisons are helpful, but their usefulness is limited. Year-by-year comparisons are better, but they take a long time to accumulate—too long, if a problem crops up fast and quickly grows to dangerous levels.

Fig. 1

Solvency Ratios

1) Quick Ratio = $\frac{\text{Quick Assets}}{\text{Current Liabilities}} = \frac{\$8,600}{\$5,420} = 1.59$ to 1

2) Current Ratio = $\frac{\text{Current Assets}}{\text{Current Liabilities}} = \frac{\$2,000}{\$1,000} = 2$ to 1

3) Current Liabilities to Tangible Net Worth =

$\frac{\text{Current Liabilities}}{\text{Tangible Net Worth}} = \frac{\$2,400}{\$6,000} = 40\%$

Fig. 2

Profitability Ratios

1) Turnover of Working Capital = $\frac{\text{Net Sales}}{\text{Working Capital}} = \frac{\$15,000}{\$3,000} =$

5 times (for period under analysis)

2) Net Profits to Net Worth = $\frac{\text{Net Profit}}{\text{Tangible Net Worth}} = \frac{\$6,000}{\$30,000} = 20\%$

3) Turnover of Tangible Net Worth = $\frac{\text{Net Sales}}{\text{Tangible Net Worth}} =$

$\frac{\$15,000}{\$6,000} = 2.5$ times (for period under analysis)

There is a way to get information from each Balance Sheet, each Operating Statement, at once. It's called Ratio Analysis. It clarifies certain relationships between elements of the Balance Sheet, Operating Summary, or both.

Without ratio analysis, a single Balance Sheet tells you only what you own and what you owe at a given instant. A single Operating Statement can tell you only what you've taken in and what you've spent.

Ratio analysis depends on the relationships between various elements of your Balance Sheet or Operating Statement. It gives you guides to assess your business position from that single Balance Sheet or single Operating Statement. Usually, the ratios you derive are compared to those typical of your industry.

Such data are lacking, at present, for the electronic service industry. **ELECTRONIC SERVICING** has attempted to gather such information through its Cost of Doing Business studies. But, complete, detailed information is not easy to obtain—small shops don't keep records, or keep only very sketchy ones. And, the typical shop **is** a small shop. Hopefully, our continued efforts to obtain such data eventually will enable us to provide you with standards for the electronic industry against which you can compare your ratios.

Bankers usually have approximate ideas of what sound ratios for any business should be—although they, too, look to industry associations and special reporting services for more specific data. They use ratio analysis for guidance when considering loans to any business.

Basically, there are only half a dozen ratios, or so, that are applicable to your business. There are many more than that, but not all are appropriate to small businesses, proprietorships and partnerships. Before we look at these ratios, review the accompanying list of principle terms used in ratio analysis.

### What Ratio Analysis Can Tell You

Following are the three major categories of information revealed by ratio analysis:

**SOLVENCY**—Your debt-paying ability. Usually it involves ratios that analyze your Working Capital, the distribution of your Assets, and sometimes the LIQUIDITY of those assets.

**PROFITABILITY**—This tells you what kind of manager you are. After all, if you're not making as much on the money you have in your business as you could from depositing it in a savings account, or in stocks, your money isn't doing all it should for you. Profitability also tells you what your growth is, and is likely to be.

**LIQUIDITY**—This is the ability to move your working capital into necessary uses instead of having it tied up.

When you seek a loan from your bank, your banker will consider first the "Solvency Ratios." These are the "Quick Ratio," the "Current Ratio," and the ratio of Current Liabilities to Tangible Net Worth.

He probably won't stop there. He'll investigate the Profitability Ratios, too. He'll look at the Turnover of Working Capital, the Turnover of Tangible Net Worth, and the Ratio of Net Profits to Tangible Net Worth. His investigations will tell him whether you're a good loan prospect, whether you can pay off your loan as things now stand, and whether you'll be able to pay it back under adverse conditions.

### Solvency Ratios

The Solvency Ratios are shown, as formulas and examples, in Fig. 1. Let's look at them, and see what they can tell us.

**The Quick Ratio** (Fig. 1—Item 1)—Sometimes called the Acid-Test Ratio, it offers an easy check on the distribution of your current assets. It shows whether or not your assets are where you can get to them and use them. In the absence of any conclusive industry figures, a ratio of around 1 to 1 is the accountants' best advice.

**The Current Ratio** (Fig. 1—Item 2) is probably the basic ratio—It measures the availability of liquid assets to meet obligations falling due within the year. Working capital is not, of itself, a valid measure of debt-paying ability—but the relationship of working capital to debt is. Let's illustrate this with an example:

Company A has Current Assets of $10,000 and Current Liabilities of $8,000. Its working capital, or net assets, is $2,000.

Company B has Current Assets of $3,000 and Current Liabilities of $1,000. It also has $2,000 Working Capital.

Shrinkage or business reversals can hurt Company A badly. But, Company B's Working Capital can shrink to half its value (as when inventories become outdated) and the company still has enough to pay its bills. This shows you why the **RATIO** rather than the actual amount is so important.

Most Current Ratios vary during the year, but bankers like one that doesn't fall much below 2 to 1. There's an old saying that "Two-to-one is good, but three-to-one is better." It's a fair enough guide.

**The Ratio of Current Liabilities to Tangible Net Worth** (Fig. 1—Item 3) is a gauge of financial condition by a direct comparison of what's owned with what's owed. The answer is a percentage figure rather than a ratio, showing what share of the business is yours and how much your creditors actually own. Expert opinion says that—under certain conditions—this percentage can run as high as 80 percent. But, at that stage your business has a top-heavy liability burden. Normally, 60 percent is considered a danger signal. At that level, the equity of creditors is about as great as your own, and a slowdown in business could be embarrassing.

Debt is always a problem to small businessmen. You can only reduce it by one of three routes—by putting more of your own personal capital in the business, by liquidating assets or by accumulating capital from earnings. You might not have additional capital to invest in your business; you might need the tools, equipment or other assets you might liquidate, to stay in business; and it takes time to accumulate capital from earnings. Which is why sound debt management is crucial to the success of a small business.

### Profitability Ratios

**Turnover of Working Capital** (Fig. 2—Item 1) gives you an idea of how efficiently your working capital is

## Principle Terms Used In Ratio Analysis

**Current Assets**—You'll remember that assets are what you own. They can be broken down into fixed assets and current assets. Current Assets are your Cash, Merchandise inventory and Accounts Receivable.

**Fixed Assets**—Fixed Assets are your furnishings, equipment, tools and building, if you own it, and your trucks or service cars. Roughly, Current Assets are convertible to cash in the course of a business cycle—Fixed Assets are not.

**Quick Assets**—These are Current Assets which can be converted to cash very quickly, in times of need. Accountants vary in their definition—some say convertible to cash within 60 to 90 days, others say within a year. Actually, it depends on the kind of business you're in—a small service business needs faster convertibility than a medium-sized or big manufacturing business.

**Current Liabilities**—Like Assets, Liabilities are either Current or Fixed. Current Liabilities are those debts which are short-term—Accounts Payable and Notes Payable in a year or less.

**Fixed Liabilities**—Long-term debts, like mortagages, which are payable over a period longer than a year. Usually—but not always—a Fixed Liability is tied to the purchase of a Fixed Asset (land, buildings, trucks or expensive laboratory equipment).

**Tangible Net Worth**—For our purposes, the value of your proprietorship, from your Balance Sheet.

**Working Capital**—The funds you have to work with. For our purposes, Working Capital is determined by subtracting your Current Liabilities from your Current Assets.

**Net Sales**—Your total take from sales of labor and materials, after adjustments and returns are subtracted.

**Net Profit**—The money left after payment of expenses, as shown by your Operating Statement.

used to produce sales, or income. A low ratio indicates an unprofitable use of working capital. A too-high ratio shows that you're vulnerable to creditors. This is so because a low ratio shows that you have a large amount of working capital lying idle, in proportion to your sales or income, while a high one shows you're operating close to the line—not increasing working capital as your business increases. This means that everything must click—no slowdowns, no sudden calls on your cash.

Lack of industry figures for electronic service firms makes this a "guesswork" ratio, but it's relatively safe to say that 4 or 5 to 1 is a minimum and 10 to 1 a maximum.

**Ratio of Profits to Tangible Net Worth** (Fig. 2—Item 2) is one measure of return on investment. If your return is too low, you can better use the capital elsewhere. Of course, in the case of an electronic service business, the investment allows you the means to sell your skill and labor—but, as one accountant told a group of lumber dealers: "You can get 6 percent on your money in blue-chip stocks and work for somebody else." This advice might apply to a marginal producer in any business, unless "being his own boss" is worth the premium he's paying for it.

**Turnover of Tangible Net Worth** (Fig. 2—Item 3) shows you whether or not the capital invested in your business is actively working to produce profits. If the turnover is too low, your capital is underworked. If it's too high, capital is being overworked. Either one is unhealthy. Underworked capital means some of your money is loafing. Overworked capital means your money is under stress. Again, everything has to click —or there's trouble.

Lack of valid figures for the industry makes a declaration of opinion about the limits of Net Worth Turnover relatively hazardous. A "ballpark estimate" to start with is 3 to 1 minimum and 6 to 1 maximum. As you follow this ratio, you'll be able to tell something from the "feel" of your business—if you're comfortably aware that no upset, short of a real catastrophe, can drive you to the wall, and that you couldn't produce more profits without a capital expansion program, you're probably in fair shape. An accountant can help you decide this.

Fig. 3

Helpful Miscellaneous Ratios

1) Inventory Turnover = $\frac{\text{Cost of Goods Sold}}{\text{Average Merchandise Inventory}}$ =

$\frac{\$7,000}{\$2,000}$ = 3.5 times (for period under analysis)

2) Net Profit to Net Sales = $\frac{\text{Net Profit}}{\text{Net Sales}} = \frac{\$6,000}{\$36,000}$ = 16.6 %

### Other Helpful Ratios

**Turnover of Inventory** (Fig. 3—Item 1) is an important ratio for retailers. It's less important for you, but it still has value. Your inventory dollars should be profitably, and effectively, applied. This means doing the maximum amount of business with a minimum amount tied up in inventory, which boils down to having, on hand, what's needed, when it's needed, for the most common repairs. Although it costs too much to run to the jobber's after a part you use once every two weeks, it might be more economical to run after one you use only twice a year rather than to stock it. (We'll treat this more fully in a later article.)

The ratio tells you the average turnover in the course of a period for your inventory—usually a year. There isn't a hard and fast rule—a supermarket may turn its inventory 25 or 30 times a year, while a luggage store turns only 2.5 times a year. Again, industry averages would be helpful here. You might even have to examine your parts inventory item-by-item, to learn how fast each item turns, or whether you really need to carry it in stock and to find out how many you need to carry. Too large a parts inventory can be risky—if new models outmode a part, you might be a long time getting your money out of a large reserve stock of that part.

Three times a year would be a pretty fair average turnover. Less than that, you should consider the cost of the item versus its turnover. More than that might suggest that you carry a slightly larger stock of that item.

**Net Profit to Net Sales** (Fig. 3—Item 2) tells you the percentage of your sales dollar you get to keep. It is a relatively good gauge of profitability.

### Special Considerations

When analyzing the preceding ratios, several factors must be kept in mind:

1) **They are rules of thumb—not absolutes.** They compare to the industry averages, or to the experience of others. There are thriving businesses which don't conform to some of these ratios—businesses that are safe, solvent and well-managed.

2) **One ratio doesn't make a summer, like one swallow.** Each must be considered in the light of the others.

3) **Every ratio depends on the figures that make up its factors.** For example, if your inventory contains a thousand dollars' worth of outmoded tube-types, you'll have to adjust your inventory for that—otherwise your current ratio will look healthier than it really is.

4) **These discussions of ratios don't make you an expert.** Consult someone who is, to be sure of what your ratios say. Your banker, your accountant, your bookkeeping service, have experience interpreting Balance Sheets and Operating Statements. Ask them.

5) **The ratios are safe limits. You may not want to be average**—if you can be exceptional and get good results, go ahead! But, understand the ratios, and keep them in mind. They **do** have value for the guy who understands them—even when he can afford to ignore them. ▲

# The right replacement, faster with

# 8 new service kits

# from your Centralab distributor


**KITS AVAILABLE:**

- Fastatch II® Controls
- Miniature Wirewound Controls
- Miniature Trimmer Controls
- Axial Lead Electrolytics
- PC Lead Electrolytics
- General Purpose Capacitors
- High Voltage Capacitors
- Packaged Electronic Circuits

**KIT FEATURES:**

- Rugged steel frames with high impact plastic drawers.
- Stackable or wall mounted.
- Portable, with convenient handles.
- All contain assortment of the most popular and widely used Centralab components.
- All control units (KIT-10F, -20W, -30T) include latest edition of H. W. Sams Replacement Control Guide.
- All components are functionally arranged in drawers by value, type, etc.
- All drawers are pre-labeled clearly showing contents.
- All kits are completely set up, ready to use.

DISTRIBUTOR PRODUCTS

CENTRALAB
Electronics Division
GLOBE-UNION INC.
5757 NORTH GREEN BAY AVENUE
MILWAUKEE, WISCONSIN 53201

**By Centralab, your Parts-Time Helper**

DS-7114

*Circle 19 on literature card*

# "Signal" and "No-Signal" Voltages in TV

Many of the DC voltages in a television receiver vary according to the signal strength of the station tuned in. However, most schematics offer no information about the average voltages obtained with a received signal.

Most manufacturers prepare a representative, normally-operating receiver of each model line by correctly adjusting it on a strong station signal. The channel selector then is turned to an unused channel, the antenna leads are removed, and the antenna terminals are shorted together. The DC voltages then are measured, and the values thus obtained are put on the schematic. If only one DC voltage is listed for a testpoint, that voltage is typical **only** for no-signal conditions.

Unfortunately, the customer does not operate the receiver under no-signal conditions, nor do we often attempt troubleshooting without a signal. Occasionally, a fellow technician, while asking for technical advice, has told me that the voltages he had measured on-station in a certain circuit were correct according to those indicated on the schematic. If the circuit was one of the many whose voltages are affected by signal strength, it was certain that the "correct" voltages actually were incorrect.

Because the manufacturers do not list strong-signal voltages, you must do it yourself.

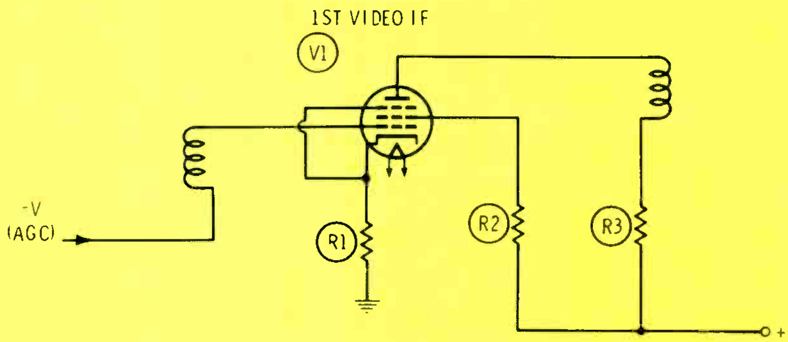



**Fig. 1** Simplified schematic of 1st video IF amplifier. Values of resistors shown here determine how much the voltages vary from "no-signal" to "with-signal" conditions.

### Write "With-Signal" Voltages on The Schematic

It has been suggested several times that strong-signal voltages be written on the schematic after the circuit is repaired. Obviously, this suggestion is of value only for the **second** repair of each circuit.

### Use a Standard Test Signal

A consistent and reliable test signal must be used to insure that the test condtions are standard. In many areas, the strength and quality of the broadcast signal varies too much to be used as a standard. Consequently, we suggest that you use a signal generator as a substitute.

A color-bar generator is an excellent choice for such a standard. It provides video or color modulation, and sync pulses for locking the receiver. Most such generators have a 4.5-MHz carrier, which helps accurately set the receiver fine tuning.

Another possibility is a marker generator, which can be amplitude modulated by an audio tone. Such a generator offers the advantage of a calibrated attenuator, and it can be used also for signal injection tests.

### Establish the Same Conditions Each Time

Whatever the source of the standard signal you select, either station or generator, operate it and the receiver the same way each time you make DC voltage measurements. Only by this method will the test conditions be consistent, or standard.

### AGC Action Causes Voltage Changes

Voltage changes in the tuner, video IF's, and video amplifier stages caused by AGC action are greater than any voltage variations caused by parts and tube tolerances.

Because normal AGC voltages vary from one receiver to another, you will have to examine the individual circuits to determine how large these variations normally should be.

#### Cathode resistances provide a clue

The amount of variation of AGC voltages supplied to the IF stages should be in proportion to the value of the cathode resistors. The larger the value of the cathode resistor of a tube that is AGC controlled, the larger the AGC voltage. The following two examples should make this clear.

#### Small values of cathode resistors produce small AGC voltages

The schematic of a 1st video IF amplifier and the essential DC components is shown in Fig. 1. When required, negative AGC voltage is supplied to the grid to reduce the gain of the tube. For a specified gain reduction, the plate current must be reduced to a certain value; for example, the plate current might require reduction from 15 milliamperes to 1 milliampere. And any voltage dropped from cathode to ground must be reduced by a factor of 15.

If R1 is 47 ohms, the no-signal cathode voltage will be .705 volt, and with a strong signal and normal AGC action the cathode voltage will be .047. The amount of AGC voltage normally applied to the grid is assumed to be zero with no signal (to simplify the concept) and –8 volts with a strong signal. Relative to –8 volts, levels of cathode-to-ground voltages are small enough to be ignored. Consequently, only the variation of the DC voltage at the grid is considered to be the range of the AGC voltage.

#### Large values of cathode resistors produce large AGC voltages

In many other TV receivers, R1 is 1500 ohms. The no-signal cathode-to-ground voltage drop is 22.5 volts (assuming the AGC must reduce the 1st video IF cathode current from 15 milliamperes with no signal to 1 milliampere with a strong signal), and the strong signal voltage is 1.5 volts. This cathode voltage change of 21 volts is much too large to dismiss from AGC considerations.

To maintain an 8-volt increase of tube bias as a result of AGC action during strong-signal reception, the –8 volts must be added to the +1.5

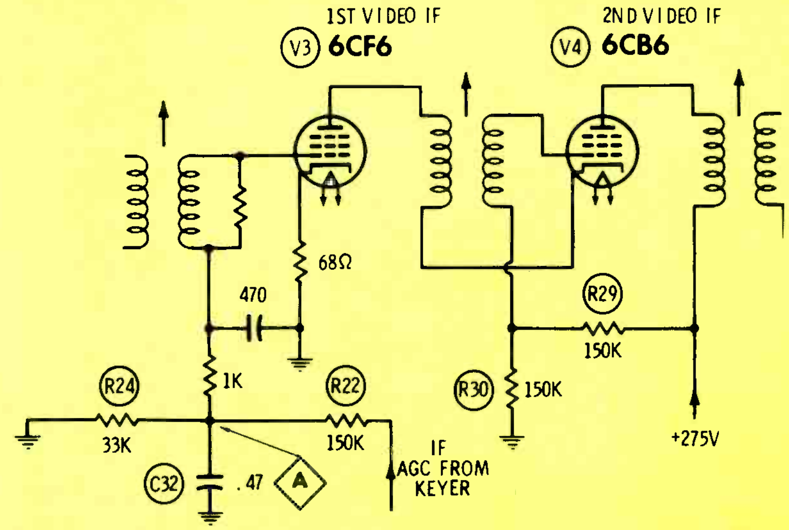



**Fig. 2** Simplified schematic of two video IF stages, one of which is controlled directly by AGC voltage and the other indirectly. AGC voltage is applied directly to the grid of V3, controlling its conduction. An increase or decrease of the conduction of V3 changes the cathode voltage of V4, varying its conduction in step with that of V3.

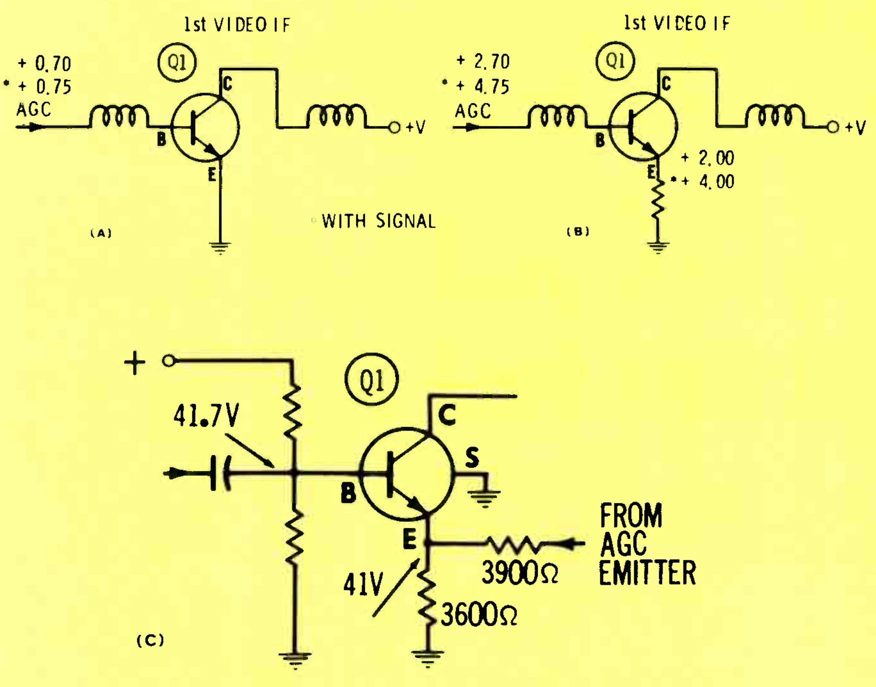



**Fig. 3** How much the AGC voltage must change to produce a specific reduction of gain is dependent on the value of the emitter resistor. A) With no emitter resistor the AGC voltage has to change only .05 volts. However, the circuit has no thermal stabilization. B) With a relatively small emitter resistor, the actual base-to-emitter bias change is about the same as in (A), but the base and emitter voltages relative to ground vary considerably more. C) With a large emitter resistor, larger changes of AGC voltage are necessary to provide relatively small changes of base-to-emitter bias.

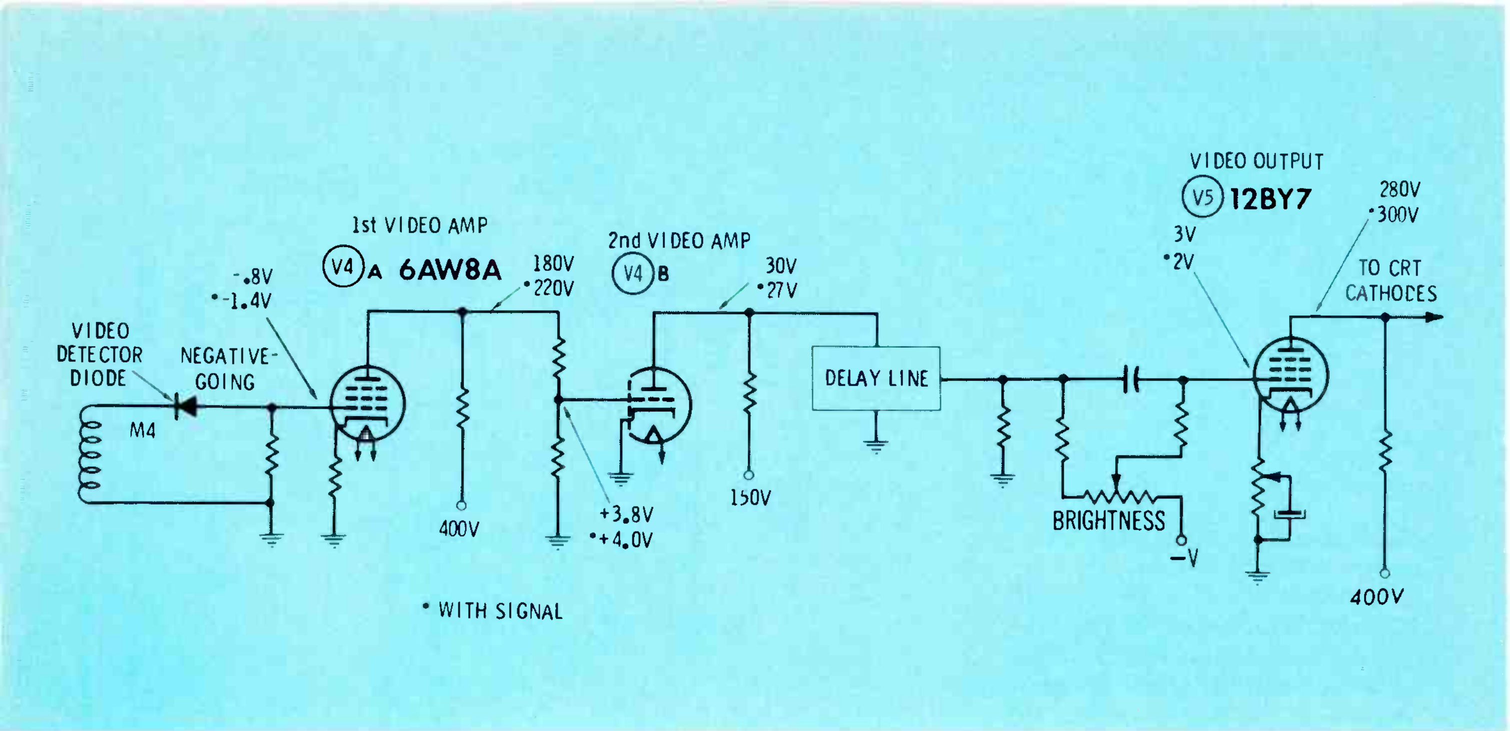



**Fig. 4** Simplified schematic of the video circuitry of the RCA CTC15 color TV chassis. Voltages with and without a strong signal are shown. Although not revealed by the levels shown on the schematic, the voltages on the video output stage vary considerably when the brightness control setting is changed, as explained in the text.

volts. The result is that the AGC voltage on the grid should be –6.5 volts with a strong signal applied to the receiver.

The desired grid-to-cathode tube bias with no signal applied is .705 volt. Therefore, the DC voltage at the grid of V1, when there is no signal, should measure relative to ground 21.795 volts. (This is the cathode voltage of 22.5 volts less the desired .705 volt.)

The total change in the voltage from cathode to ground is 21 volts. However, a grid voltage change (relative to ground) of 28.295 (21.795 added to –6.5) is necessary to cause that much change in the cathode-to-ground voltage.

In both of the previous examples, the true grid-to-cathode bias change was the same. Nevertheless, the volttage changes between signal and no-signal conditions were substantially different, when measured in the usual way in relationship to ground.

These two examples make possible these conclusions: A small value of cathode resistor in the 1st video IF amplifier stage causes a grid-to-ground AGC voltage that is small and has a small variation. A large value of cathode resistor in the 1st video IF amplifier stage produces a grid-to-ground AGC voltage that is large and which has a large variation.

#### Variation of plate voltages

Variations of the screen and plate voltages as a result of AGC action also depend on the value of R2 and R3 in Fig. 1. The larger the values of these resistors, the larger the voltage variations.

#### Phantom AGC action

Another circuit variation used in some tube-equipped video IF sections is shown in Fig. 2. AGC voltage is applied directly to the grid of V3 and indirectly to the cathode of V4. Any change in the conduction of V3 also produces a proportional change in the conduction of V4.

Because V3 and V4 are connected in series to B+, V4 effectively functions as the plate dropping resistor for V3. If the AGC voltage applied to the grid of V3 increases (more negative), its conduction decreases and the voltages on its plate increases (more positive). This increase of voltage also exists on the cathode of V4, producing the same effect as the application of a negative voltage to its grid. (A positive potential developed by a voltage divider consisting of R29 and R30 is applied to the grid of V4.) Thus, the effect of the AGC voltage on the grid of V3 was passed on to V4—the bias of both tubes was increased and their gains were decreased.

Space does not permit an analysis of the effects of component defects in this circuitry. However, it is evident that the recording of normal "with-signal" and "without-signal" DC voltages on the associated schematic would be particularly beneficial for troubleshooting a circuit such as this.

#### Estimating AGC voltages for transistors

How much the AGC voltage to a transistor changes between no signal and strong-signal conditions depends mostly on the value of the emitter resistor. The schematics in Figs. 3A and 3B show two possible sets of conditions. Both reduce the gain the same amount.

In Fig. 3A, the emitter of the transistor is grounded. Therefore, to accomplish a large gain reduction by the saturation effect, the base voltage is increased only .05 volt. This exact circuit is seldom used, because it provides no thermal stabilization.

In a more practical circuit, such as that shown in Fig. 3C, the circuit action is reversed. A fixed voltage from a low-resistance voltage divider is applied to the base, and a relatively large resistor is connected from the emitter to ground. Forward AGC action is accomplished by reduction of the emitter-to-ground voltage by a 3900-ohm resistor. This produces the same effect

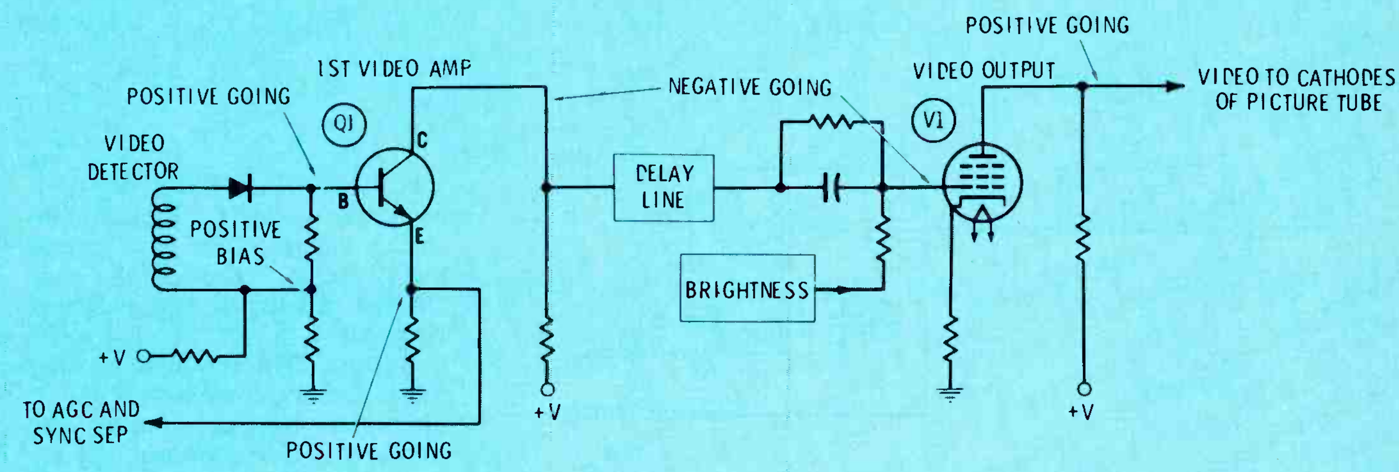



**Fig. 5** Only two video amplifier stages are used in this hybrid design. The plate of V1 becomes more positive (less brightness) when a strong signal is received.

as increasing the base voltage.

If the emitter voltage without signal is +41 volts, a virtually unmeasurable decrease to about +40.95 volts produces normal AGC action. The bias change is .05 volt, the same as was given in the example of Fig. 3A. It is best to measure this voltage from base-to-emitter. (Use the 470K-ohm resistors and the .1-mfd capacitor for isolation, as shown in Fig. 8.)

An example of the AGC supply voltages to be expected when a large emitter resistor is supplied is shown in Fig. 3B. The variation of the base-to-emitter voltage is the same as that in the other two examples, but both the base and the emitter voltages relative to ground change substantially. This circuit, when analyzed by the DC operation, could be called an emitter follower. Application of a more positive voltage to the base increases the forward bias which, in turn, causes more emitter current. The increased emitter current increases the emitter voltage to almost the same level as the increased base voltage.

Because the gain of a transistor DC amplifier is so much higher than a tube-equipped circuit, there is little change in the bias because of the large change in the base and emitter voltages relative to ground.

A quick test of the AGC action is to measure the voltage drop across the emitter resistor, both with and without a signal. However, the value of the emitter resistor should be measured first, because a wrong value will reduce the accuracy of the test.

### Voltage Changes in The Video Circuits of Color Receivers

Most color receivers (with only two or three exceptions) employ DC coupling in all stages between the video detector and the picture tube, as shown in the simplified schematic in Fig. 4. The video detector in Fig. 4 is negative-going; in other words, the output of the video detector becomes more negative when the signal strength is increased. Because the phase of this voltage change is inverted in each subsequent video stage, it becomes the required positive-going signal at the cathodes of the CRT. Thus, the cathodes become more positive as the strength of the received signal increases: the stronger the signal, the darker the picture on the screen.

In practice, the plate of the video output tube becomes 20 to 30 volts more positive when a strong signal is received than it is when no signal is being received. This fact must be considered in any analysis of the DC voltages that are concerned with brightness.

An added complication to voltage analysis is the fact that the bias of the video output tube is variable by means of a brightness control. When varied from one extreme to the other, this control changes the voltage at the plate of the video output tube about 80 or 90 volts. Any large change in the positive or negative voltages present at the ends of the brightness control will cause the plate voltage swing to be in the wrong range of voltages. If the negative voltage becomes dominant, the plate voltage will always be too high, causing a dark picture. If the positive voltage dominates, the range of plate voltages caused by brightness control variations will be too low; the picture will be too bright, or it will bloom out.

The recommended test for the DC voltage at the plate of the 12BY7 (and this includes the DC condition of all three video stages) is to tune in a station, make sure the AGC is adjusted correctly, and then monitor the plate voltage of the 12BY7 video output tube while the brightness control is turned from one end to the other. Write down this range of voltages, if the receiver seems to be operating normally. The range should be approximately from 250 to 360 volts.

The schematic shown in Fig. 5 is typical of the video circuit in

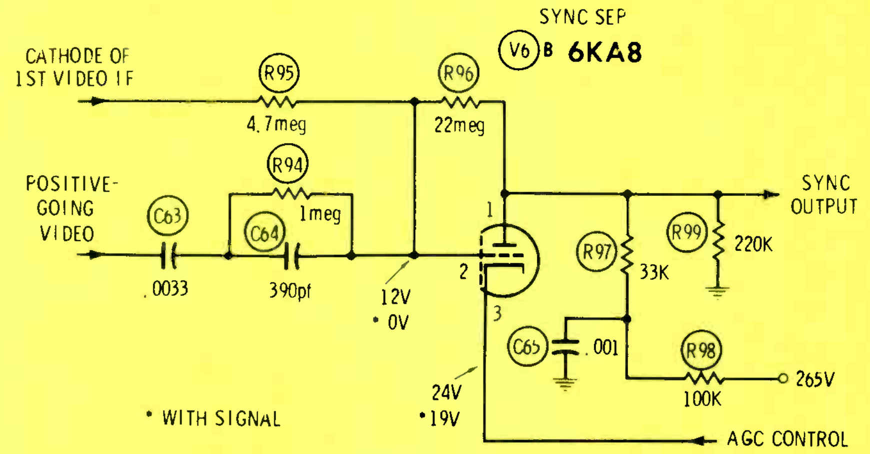



**Fig. 6** This is the sync separator circuit of the RCA CTC15 chassis. Grid-cathode rectification of the video signal causes a negative voltage to appear between grid and cathode. The negative voltage changes when the composite video signal is changed at the station or when the video level at the grid changes. The larger the signal at the grid, the more negative the voltage measured there. The plate voltage changes only slightly; any change is reduced by R99, the plate-to-ground resistor.

many hybrid television receivers. The polarity of the video detector is opposite that in most all-tube designs; it is positive-going. After one phase reversal in Q1 and another in V1, the signal at the cathodes of the picture tube is positive-going.

The plate voltage of V1 also becomes 20 to 30 volts more positive with a strong signal than with no signal.

The brightness control (in either the grid or cathode circuit, according to the model) changes the bias of V1. The resultant large change in plate voltage must be taken into consideration during DC voltage analysis.

### Voltage Changes in Sync Separators

DC voltages in sync separators change as the TV station changes the level of horizontal blanking and video in the composite waveform. To a lesser extent, the voltages also change according to the strength of the station tuned in; however, good AGC action minimizes these voltage changes.

Typical of single-stage, tube-equipped sync separators is the circuit shown in Fig. 6. The grid and cathode function like a diode in a shunt rectifier circuit. Rectified DC voltage, stored in C63, measures negative from the grid to the cathode. Plate current flows only when grid current flows. The grid is biased to cut-off during the remainder of the time.

When the composite waveform is rectified, grid current flows only during the horizontal sync time. Therefore, the output signal at the plate should consist mostly of amplified sync pulses. Component defects that cause **any** rectifier circuit to malfunction, also can cause the grid circuit of the sync separator to malfunction.

Calculating from the voltages given in Fig. 6, without a station signal the bias of the sync separator tube was –12 volts, and with a strong station signal the bias was –19 volts—a difference in bias of –7 volts.

The grid resistors of this circuit, R94 and R95, return to positive sources. In another design, R95 was 2.2 megohms and was returned to ground. The bias was –2 volts with no signal and –20 volts with a strong signal. Circuits which return the grid resistors to ground apparently change grid bias more than those which return the resistors to a positive source.

Voltage variations in transistorized sync separator circuit are less spectacular than those in tube-equipped circuits. The base-to-emitter voltage of the sync separator shown in Fig. 7 changes only .14 volt between strong signals and no signal.

Because Q18 is an NPN transistor, the negative voltages shown are reverse bias; consequently, the transistor is biased substantially beyond cut-off between horizontal sync pulses. The tube equivalent is a highly negative grid-to-cathode voltage.

Base-to-emitter rectification takes place in Q18, just as rectification occurred in the tube-type separator circuit; the transistor is forward biased and amplifies only when the horizontal sync pulse is present at the base. The output at the collector is mostly amplified horizontal sync pulses.

Space limitation has permitted only a superficial explanation of some of the television circuits whose voltages change according to the strength of the received signal. However, we hope these examples will convince you to start (or to continue) measuring and recording these important "with signal" voltages.

### Voltage Errors Caused By Test Equipment Loading

A common belief is that the use of a VTVM or FET VOM for DC voltage measurements eliminates all possibility of serious errors caused by capacitive loading. After all, a 1-megohm resistor is installed inside most DC probes to reduce such capacitive loading.

However, in practice, there are several circuits in which a DC probe can cause detuning and possible changes in DC voltages. These critical circuits include the mixer-oscillator in the tuner, the video IF stages, the color-burst amplifier and the 3.58-MHz color oscillator.

For example, a DC probe connected to the plate of an IF amplifier tube might cause regeneration. If so, the voltage on the plate will read higher because of the change in AGC voltage. A voltage measurement at the decoupling capacitor and resistor on the other side of the plate coil will reveal the actual voltage level, which will be lower.

In many color receivers, connection of a direct probe to the grid of the 3.58-MHz color oscillator causes the oscillator to go out of lock, or perhaps causes oscillation to cease altogether, and with it, all color reception.

**A solution**

External components added to the leads of a VTVM eliminate most of the effects of capacitive loading.

The components shown in Fig. 8 permit accurate measurements of DC voltages across a part of a circuit that is sensitive to capacitive loading both on the "high" and "low" DC sides. Both leads of the meter are decoupled by 470K-ohm resistors, which also substitute for the usual 1-megohm resistor inside the probe. To prevent hum from the large bulk of the meter, which is "floated" above ground, the .1-mfd capacitor is added to ground (for AC) the meter wiring.

If the measurement is one for which the meter can be grounded, a 1-megohm resistor added externally to the probe tip is all that is necessary. Be sure the lead on the end opposite the probe is short. The meter common lead, which will be connected directly to ground, does not require the addition of external components in this case.

Notice that the 1-megohm resistor **must** be **outside** the case of the probe. Although most probes have a 1-megohm resistor inside, plus some kind of switching to short across it during ohms measurements, there is considerable internal stray capacitance that partially cancels the isolation action of the resistor.

Use the externally mounted resistor (or resistors) when measuring the DC in any circuit suspected of being sensitive to detuning by probe capacitance. Most misleading readings can be avoided by using this method. ▲

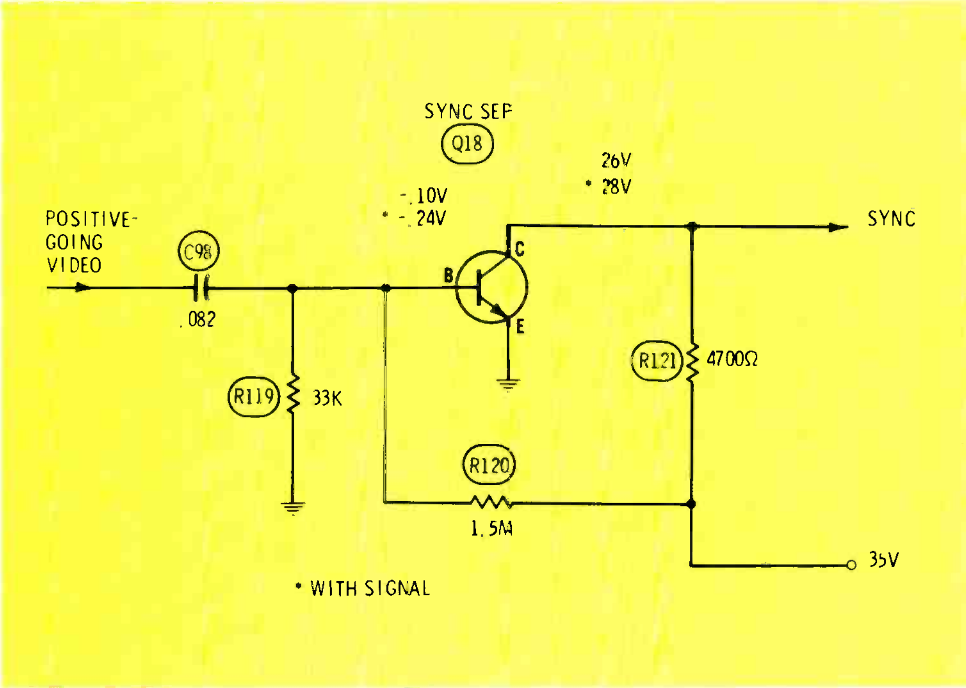



**Fig. 7** The sync separator stage of the Motorola TS919 Quasar chassis is shown here. None of the DC voltages change substantially, but even these normally small variations are important. The base-emitter junction acts as a diode in this circuit, just as the grid-cathode of the tube circuit shown in Fig. 6.

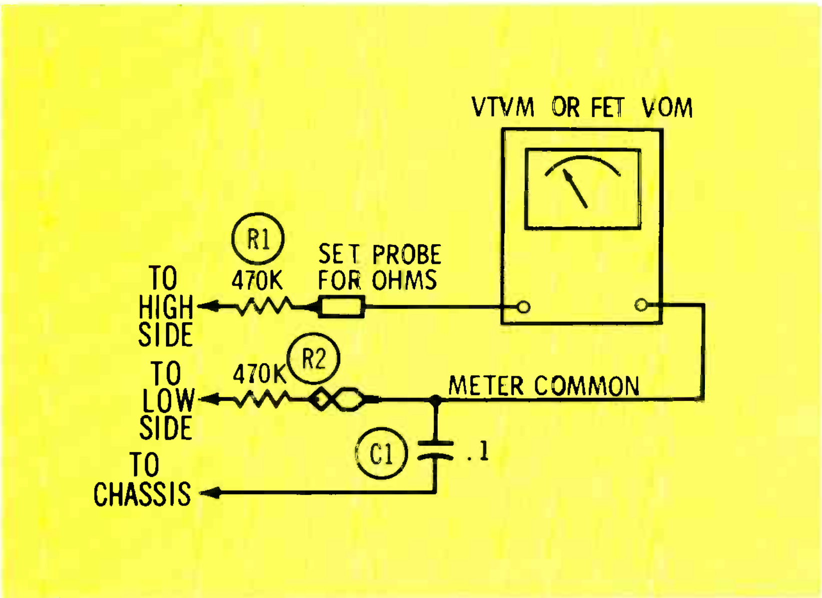



**Fig. 8** To minimize capacitive loading when measuring small DC voltages in circuits which are sensitive to capacitance changes on both "sides" of the circuit, the two resistors and the capacitor shown here can be added externally to the VTVM or FET VOM. If DC voltages are measured relative to ground, increase R1 to 1 megohm and omit R2 and C1.

shoptalk

With Carl Babcoke
ES Technical Editor

# Interpreting Vertical Sweep Conditions

Vertical sweep problems often are more difficult to analyze than problems in other more complex TV circuits. There are several reasons why this is true.

Because any multivibrator is a closed-loop circuit, defective components in one stage can cause waveform changes in other stages that are normal. Also the positive feedback signal from a defective vertical output stage can change the DC voltages and the frequency of the vertical oscillator.

The designs of most modern tube-equipped vertical deflection circuits are variations of the multivibrator.

Knowledge of the operating characteristics of basic designs of multivibrator circuits can help a technician understand the more complex variations used in vertical deflection systems.

### Types of Oscillators

An oscillator is a circuit whose output signal is fed back in phase to the input, with sufficient gain to overcome the losses of the circuit. The output of an oscillator is a continuous signal. This definition will be used to analyze each oscillator that is discussed.

Oscillators can be classified into two general categories. One type (not discussed in this article) is the sine-wave oscillator, whose frequency mainly is determined by a tuned circuit. The other type is the time-constant oscillator, whose frequency is determined mainly by the discharge time of a resistance capacitance (RC) network, and by the amplitude and waveshape of the voltage which charges the capacitors.

### A Basic Multivibrator Circuit

A single multivibrator circuit is shown in Fig. 1. The signal from each plate is capacitively coupled to the grid of the other triode tube. In other words, each tube provides positive feedback for the other. Because the circuits of the two tubes are identical, this multivibrator is referred to as a "symmetrical" type. An external signal coupled to any plate or grid will travel around the circle of the circuit and again arrive at the starting point. This shows that the circuit is a closed-loop type, although the loop is small.

All the requirements for oscillation are fulfilled by the multivibrator-type oscillator circuit. Any signal that travels around the loop arrives (with the same phase as it started) at the point of origin. Therefore, the phase requirement for oscillation is met. The gains of both tubes assure sufficient amplitude of the feedback signal to sustain oscillation.

Stability of the frequency is very poor in any free-running (not locked) multivibrator circuit. Small changes in the values of capacitances and resistances occur because of aging or the effects of heat. However, most of the variations in fre-

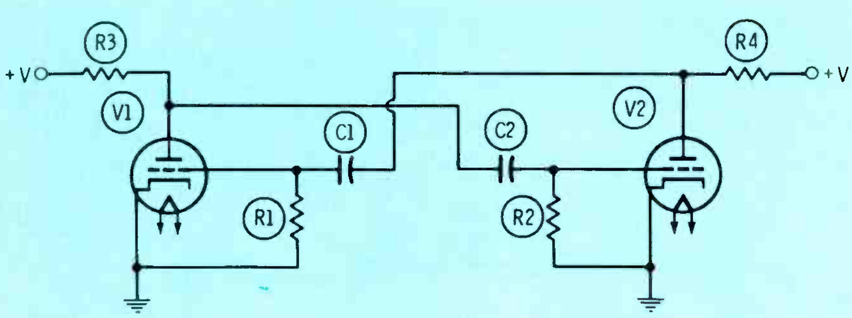



**Fig. 1** Shown here is the circuit of a symmetrical multivibrator. Because the tubes are alternately fully conducting or completely cut off, the waveform at both plates is a distorted square wave. The frequency is determined primarily by the time constants of C1-R1 and C2-R2. Assume that V2 starts to conduct plate current before V1, after power is applied to the circuit. The voltage at the plate of V2 decreases (negative-going). This negative pulse is coupled through C1 to the grid of V1. Because of the normal 180-degree phase difference between the grid and plate, the pulses at the plate of V1 (and the grid of V2 coupled through C2) are positive-going. Because of the 180-degree difference between the grid and plate of V2, the pulse at the plate of V2 is negative-going. The pulse has completed a circle and has arrived in-phase back at the starting point. Both tubes amplify and produce more than enough gain to overcome the inherent losses of the circuit, and the phases are correct; consequently, the circuit oscillates.

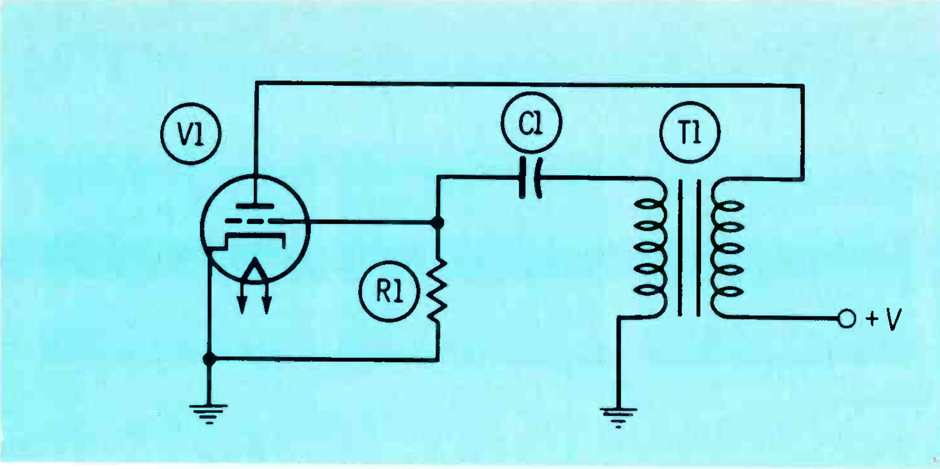



**Fig. 2** The circuit of a blocking oscillator. The plate of V1 conducts current when power is applied: this creates a negative-going signal at the plate. The phasing of T1 is arranged so that the signal from the secondary winding to C1 is opposite (or positive-going) that at the plate. The 180-degree phase change between the grid and plate of V1 produces a negative-going signal at the plate. This signal is in-phase with the original pulse. Because the gain of the tube overcomes the circuit losses and the phases are correct, the circuit oscillates.

The grid draws current on positive-going pulses, building up a negative DC voltage on the grid side of C1. Time is required for this negative voltage to discharge through R1 and decrease enough to permit plate current to flow again and continue the cycle. Therefore, the frequency of the output signal is determined mainly by the values and conditions of C1 and R1.

The plate current is a sharp pulse, which can be integrated into a sawtooth to drive a horizontal or vertical output tube.

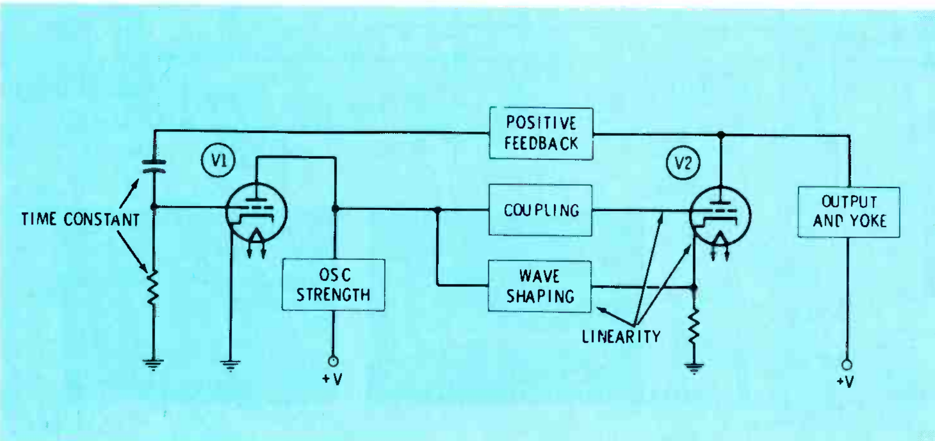



**Fig. 3** Block diagram of a typical non-symmetrical multivibrator which is used for vertical deflection. Because each plate is capacitance coupled to the grid of the other tube, the phases inside the loop are the same as those explained for the symmetrical multivibrator.

V2 is operated with slightly more bias than that required for class "A" operation. Consequently, no grid current is drawn by V2 and the only components which determine frequency are the capacitor and resistor in the grid circuit of V1. In effect, V2 takes the place of the transformer used in the blocking oscillator, except that V2 also provides power for the vertical deflection yoke.

The vertical yoke windings must be supplied with a sawtooth of current. This is accomplished by using a voltage which is a composite of a pulse and a sawtooth. The values of the resistances and capacitances used to create the needed waveforms are critical.

Vertical sync is injected at either the grid or the plate of V1. Controls are provided for height and linearity adjustments. The time-constant in the grid circuit of V1 also is made adjustable so that the oscillator frequency can be varied to match that of the vertical sync. This is called vertical locking.

quency are caused by power supply fluctuations or by changes in the amplitude of the feedback signals that are applied to the grids. Slight changes in the gain of the tubes also noticeably change the frequency.

Two time-constant networks are included in the multivibrator circuit in Fig. 1. These consist of C1 and R1, which are the grid components of V1, and C2 and R2, which are the grid components of V2. The time constant is usually the same for both networks. Any change of the value or condition of the capacitances or resistances in **either** network will change the frequency.

The grids and cathodes of V1 and V2 function as diodes which shunt rectify the AC signals present at the grids. Because of this, the DC voltage on each grid is negative relative to the respective cathode.

The frequency of the output signal produced by the multivibrator is dependent on how long each tube conducts, which, in turn, is dependent on how long sufficient negative voltage to cutoff the tube is present on the grid. This latter factor is determined by the values of the resistors and capacitors in the respective grid circuits. For example, any increase in the value of C1 or R1 increases the time required for C1 to discharge through R1. This, in turn, increases the time required for the negative voltage to drop enough to permit V1 to conduct plate current again (and thus continue the oscillation cycle). This longer time constant (larger value of grid resistor or capacitor) causes the oscillator to operate at a lower frequency.

## A Basic Blocking Oscillator Circuit

The blocking oscillator is a variation of the multivibrator. It is a non-symmetrical type (the two stages are not identical).

The blocking type of oscillator is a near-relative of the multivibrator, although it might not seem so at first thought. A simple blocking oscillator is shown in Fig. 2. There is only **one** time-constant network, C1 and R1. Tube V2 in the symmet-

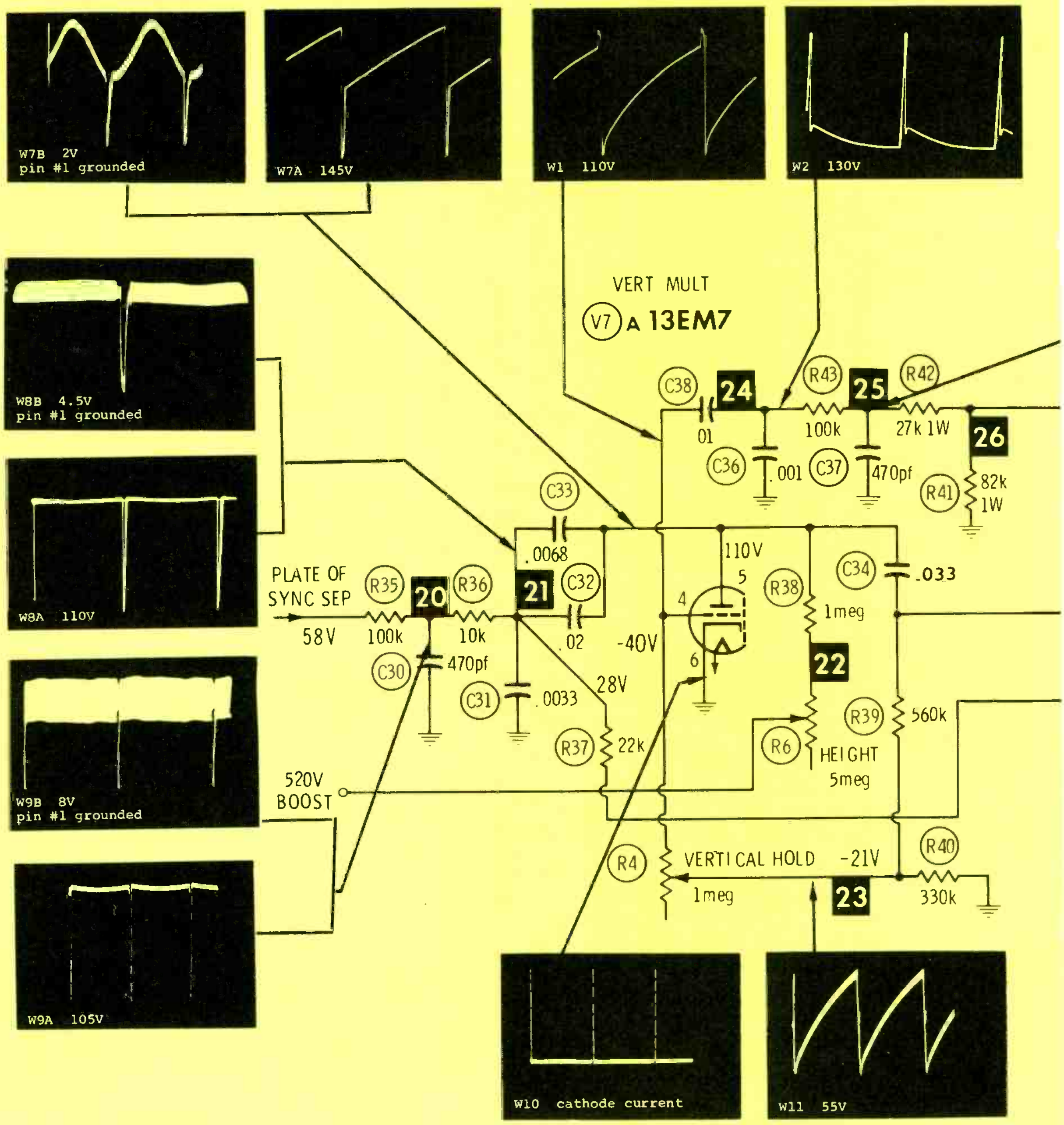


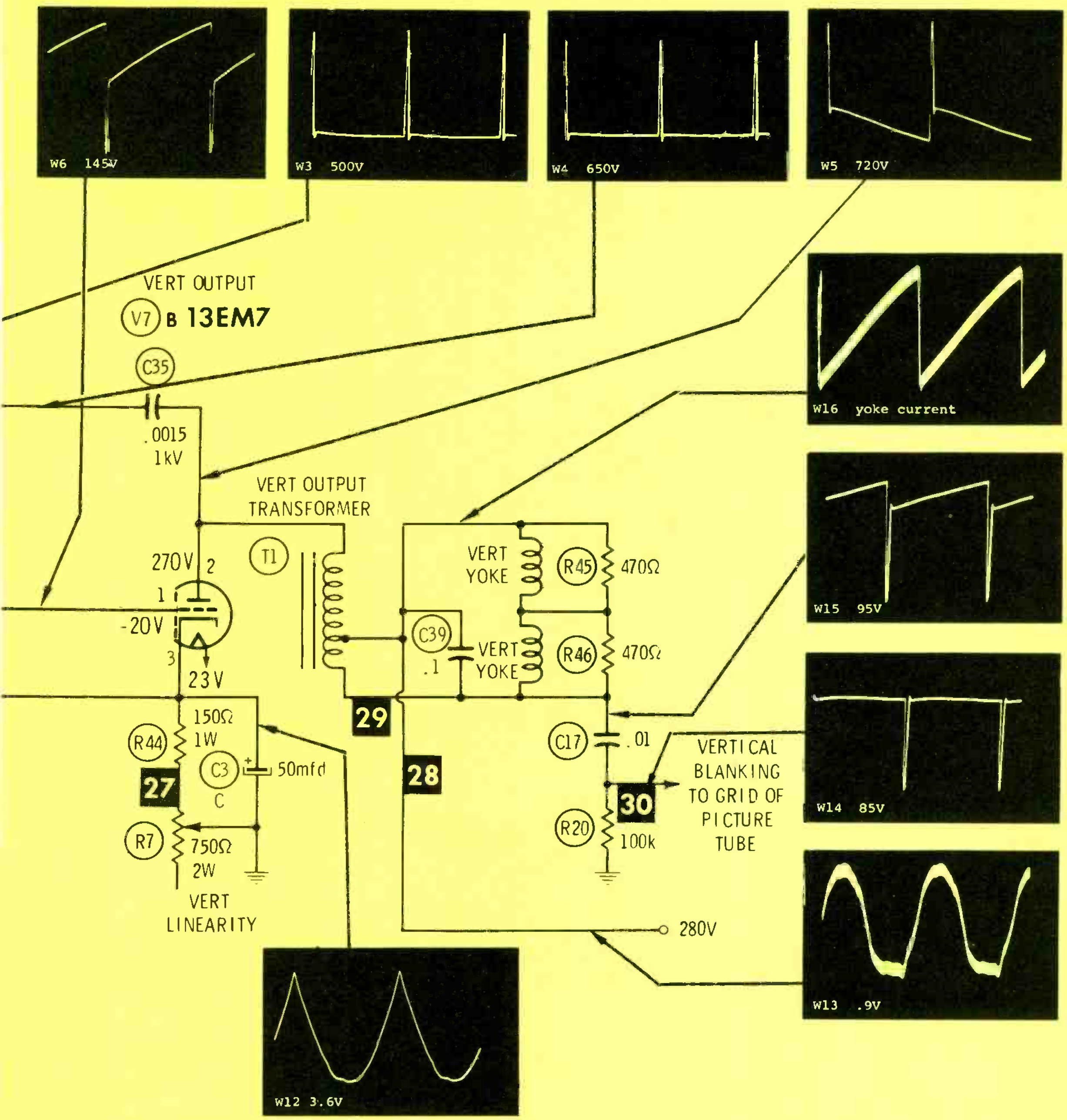

**Fig. 4** The complete vertical sweep circuit of Sears Silvertone chassis 456/528.51780. The analysis of circuit action starts at the plate of the oscillator, V7A. C34 is the coupling capacitance to the grid of the output tube. R38 and R6 (height control) are the plate load resistors; the lower the total resistance, the higher the plate voltage and the larger the amplitude of the pulse. C32 and C33, in parallel, have two functions: Coupling sync from the Circuitrace point 21 to the plate of the oscillator tube, and also, in conjunction with R37, developing the desired waveshape at the plate. The opposing temperature coefficients of C32 and C33 help stabilize against heat changes. R37 is returned to the cathode of V7B instead of ground, to provide stronger vertical sync.

Some negative voltage from the grid of the oscillator tube is applied through the vertical hold control to the grid of V7B to supplement the adjustable cathode bias of V7B, which is supplied by the vertical linearity control and R44. The cathode of V7B is bypassed by C3C to prevent degeneration and subsequent loss of gain.

Matching of the high plate impedance of V7B to the low impedance of the vertical yoke coils is accomplished by the autotransformer, T1, whose action is the same as that of a transformer, except that the two windings are not isolated. C39 is connected in parallel with the vertical yoke coils to attenuate horizontal pulses picked up by stray capacitance from the horizontal yoke coils.

The series of capacitors and resistors which are located between the plate of V7B and the grid of V7A are the components which provide positive feedback.

C38 and R4 (vertical hold control) are the major time-constant components that determine the frequency of oscillation. Defects in these components will affect frequency, not height or linearity.




rical multivibrator oscillator shown in Fig. 1 is replaced in the blocking oscillator by a transformer which gives impedance matching and phase reversal.

The frequency stability of the blocking oscillator is better than that of the multivibrator, because the transformer is more stable than the tube and time-constant components it replaces.

### A Practical Non-Symmetrical Multivibrator

A typical TV vertical deflection circuit is shown in Fig. 3, with major areas of the circuit in block-diagram form. These will be analyzed thoroughly later.

The vertical output stage in Fig. 3 has little similarity to V2 in the symmetrical multivibrator in Fig. 1. The bias of the output stage is higher than that required for class "A" operation, and the amplitude of the input signal is not high enough to cause grid rectification. The amount of grid bias required for normal operation is usually obtained by adjusting for the best linearity of the raster, especially at the top of the screen.

Because the power to drive the vertical deflection coils in the yoke is provided by the vertical output stage, the output tube usually is capable of handling more power than V1.

Only one time-constant network is provided: the capacitor and resistor connected to the grid of V1, the oscillator tube. However, if the amplitude of the drive signal from the plate of V1 is excessive or the bias applied to V2 is too low, the cou-

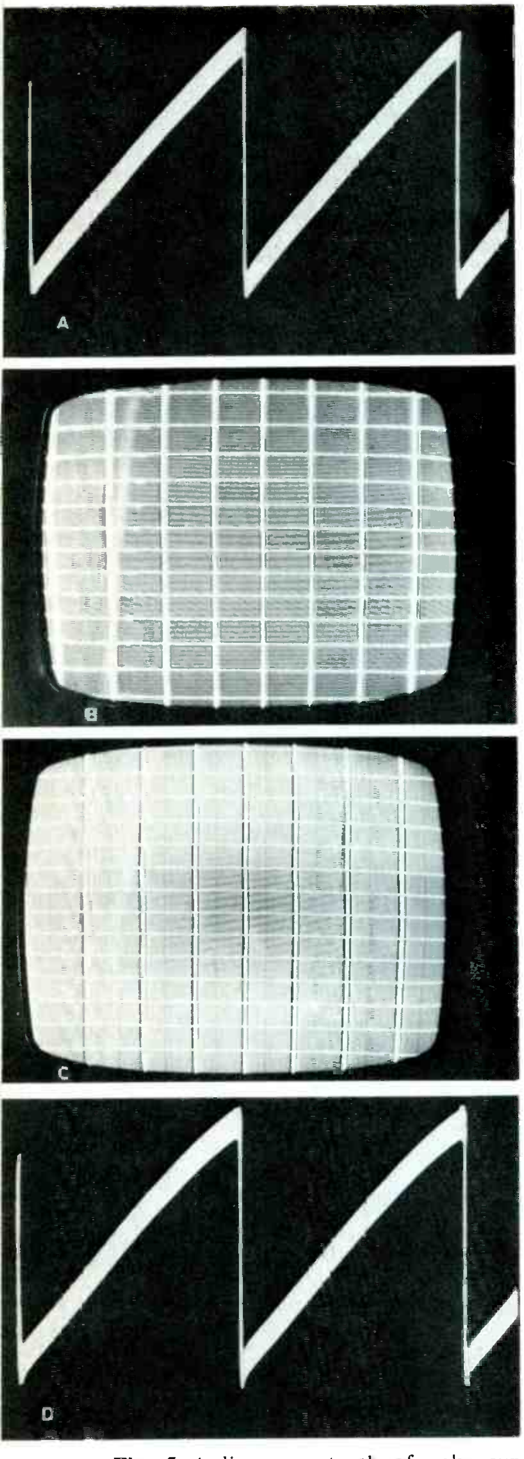


**Fig. 5** A linear sawtooth of yoke current does not necessarily produce a linear picture on the screen of the picture tube because of a side-effect from wide-angle deflection. (A) Adjusting the controls and increasing the value of C34 produced this good sawtooth of vertical yoke current. (B) The good sawtooth of (A) produced this crosshatch pattern, which is stretched both at the top and the bottom. (C) Adjusting the height and linearity controls for the best linearity of the raster produced this good crosshatch pattern. (D) The control settings which produced the good crosshatch pattern also produced a rounded sawtooth of current.

pling capacitor and resistor in the grid circuit of V2 become an additional time-constant network. Under such abnormal conditions, current flows in the grid circuit of V2. This causes the height and linearity control adjustments to affect the frequency more than the usual amount.

### Analysis of An Actual Vertical Deflection Circuit

The complete schematic of the vertical deflection circuit of the Sears Silvertone 528.51780 chassis b-w television receiver is shown in Fig. 4. This circuit is typical of the vertical deflection systems used in many b-w and some color receivers. Included in Fig. 4 are descriptions of the normal circuit operation, normal waveforms, peak-to-peak signal voltages and DC voltages.

### Yoke Current Should Be a Sawtooth

To produce linearity of the vertical sweep the vertical deflection yoke current should be a near-perfect sawtooth.

If a yoke did not have DC resistance, a pulse of voltage applied to it would be integrated into a sawtooth of current by the low-pass action of the inductive reactance. (This integration of a pulse is the same action accomplished for voltage waveforms by the low-pass filter shown in Fig. 1A on page 57 of the May, 1971 issue of ELECTRONIC SERVICING. However, because a yoke does have DC resistance, it requires a sawtooth of voltage to produce a sawtooth of current through the DC resistance of the wire. The required composite voltage waveform consisting of both a pulse and a sawtooth is shown in Photo No. W15 in Fig. 4.

Expanded deflection at the extreme top and bottom of the TV screen is an undesirable side-effect of wide-angle deflection. Many vertical circuits are designed to modify the "perfect" sawtooth of current so that the vertical sweep will appear more linear on the screen of the picture tube. Fig. 5 shows the "perfect" sawtooth of yoke current and the non-linearity it produced at both top and bottom of the screen. Also shown is the modified sawtooth produced when the height and linearity controls were adjusted for the best linearity of the crosshatch pattern on the screen of the picture tube.

In the Sears chassis, the deflection at the extreme bottom of the screen is reduced slightly by the values chosen for C34 and R39, the components in the grid circuit of V7B. Linearity at the top of the picture is dependent on the setting of the linearity control, which varies the bias on V7B.

### General Vertical Deflection Characteristics

The characteristics of any vertical deflection system are defined as follows:

- **Frequency**—the ability of the vertical system to operate at a nominal frequency of 60 Hz. This requirement is fulfilled if the vertical frequency can be varied above and below 60 Hz. In other words, the picture can be adjusted to roll down or flip up.
- **Locking**—the ability of the vertical sync pulses to synchronize the phase of broadcast and receiver vertical sweep signals so that just one stable picture is produced (see Fig. 6) when the vertical hold control is correctly adjusted. Insufficient vertical sync to lock the vertical firmly is sometimes erroneously thought by some technicians to be a frequency problem.
- **Height**—the ability of the vertical deflection system to produce a raster which covers the entire screen area.
- **Linearity**—Equal vertical spacing of the horizontal scanning lines over the entire height of the screen. If linearity is normal, the horizontal bars of a crosshatch pattern should be spaced equally.
- **Stability**—Absence of unwanted vertical motion of the picture. Examples of unstable vertical sweep are: intermittent changes in height or linearity caused by defective components or fluctuating line voltage, or a vertical shimmy occurring at 30 times a second.

### Functions and Effects of Vertical Deflection Components

Knowledge of the functions of

each part and how it affects locking, height and/or linearity if it is defective is extremely helpful.

A defect in almost any component of a vertical multivibrator sweep circuit might affect either the frequency, height or linearity. It also might affect all three in varying degrees. This is one of the difficulties in analyzing and repairing vertical sweep circuits.

In the ELECTRONIC SERVICING laboratory we have simulated defects and changed the values of **all** the components in the vertical circuit shown in Fig. 4. The results of these tests are included along with the following description of the functions of the vertical deflection components.

• **C30** (470-pf ceramic capacitor) —The first capacitance in the vertical sync integrator network. When open, it caused no noticeable change. Leakage reduced the vertical sync pulse and made locking more critical. A "near-zero-ohms" short completely eliminated the sync pulse and, consequently, vertical locking. This capacitor is not sensitive to heat or cold, and the exact value is not critical.

• **R35** and **R36** (100K and 10K) —The resistive parts of the vertical sync integrator network. The values of these resistors are not critical.

• **C31** (.0033-mfd paper or Mylar dielectric capacitor)—Has two functions: It is the second capacitance of the integrator network, and it is also a minor part of the waveshaping network connected to the plate of the oscillator tube. When open, it produced slightly better locking and slightly less height. Leakage caused slightly more height, and locking was not affected noticeably until the leakage increased to less than 27K ohms. A near-short produced more height and eliminated all vertical locking. A value of .01 mfd produced more height and softer vertical locking.

• **C32** (.02-mfd paper or Mylar dielectric capacitor)—Also has two functions: It couples the vertical sync pulse to the plate of the oscillator, and it is also the main waveshaping capacitance. C32 affected the height more, according to the value and condition, then did any other capacitor. When open, it caused excessive height at the bottom and badly compressed linearity at the top of the screen, as shown in Fig. 7. The oscillator grid voltage increased to –78 volts, an indication of the larger output signal obtained from the plate of the oscillator tube.

Leakage of only 5.6 megohms caused a 1-inch loss of height at the bottom of the picture; the plate voltage of the oscillator decreased to 90 volts. A near-short eliminated all vertical sweep. Changing the value to .05 mfd reduced the height about one half.

• **C33** (.0068-mfd ceramic dielectric capacitor)—This capacitor is paralleled across C32. Their opposite temperature coefficients make the waveshaping network less sensitive to temperature changes. This capacitor in other brands and models of TV receivers has a temperature coefficient rating of N5600. When open, C33 caused slightly more height.

• **R37** (22K-ohm carbon composition resistor)—The important resistive component of the waveshaping network. A value of 10K ohms produced slightly more height at the bottom. A value of 33K ohms produced 1½ inches less height. This resistor is not critical to heat or cold. We advise a tolerance of no more than ±10 percent.

R37 is returned to the cathode of the output tube because the ef-

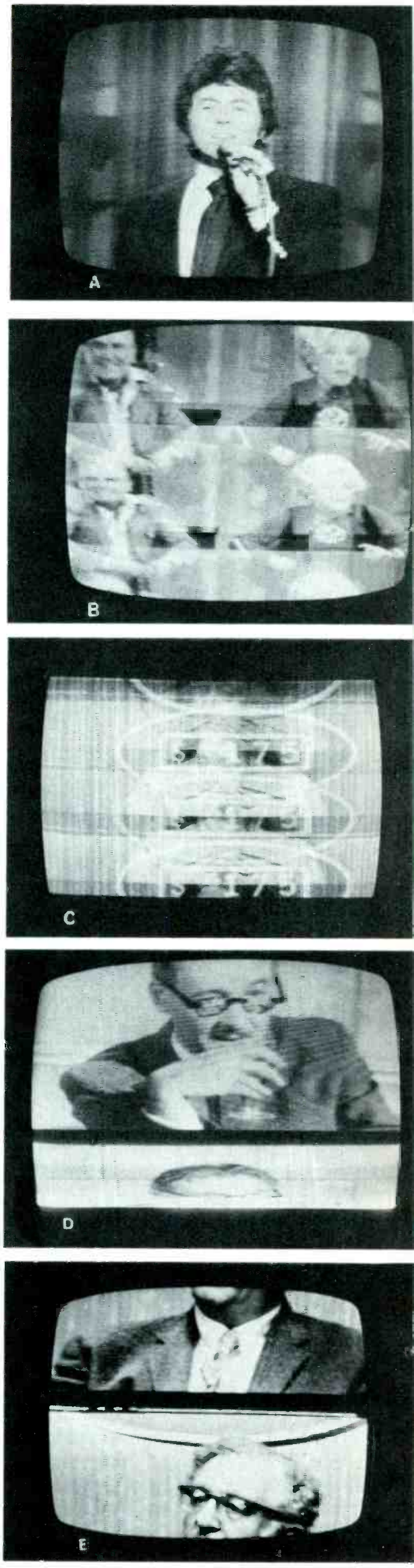



Fig. 6 Correct locking requires more than just stopping any rolling of the picture. (A) A picture normally locked at 60 Hz. (B) Incorrect hold control adjustment caused this fast rolling. (C) In this picture, the raster is not rolling, but the vertical frequency is "locked" at 75 Hz and several pictures on the raster are overlapping. (D) Two pictures on the screen with a vertical blanking bar between them, as shown here, indicate that the vertical sweep system is operating at 30 Hz. (E) A vertical blanking bar between two parts of a single picture indicates that the vertical sweep is operating near 60 Hz but is not locked.

**Fig. 7** C32 open produced excessive deflection at the bottom and compression at the top of the raster.

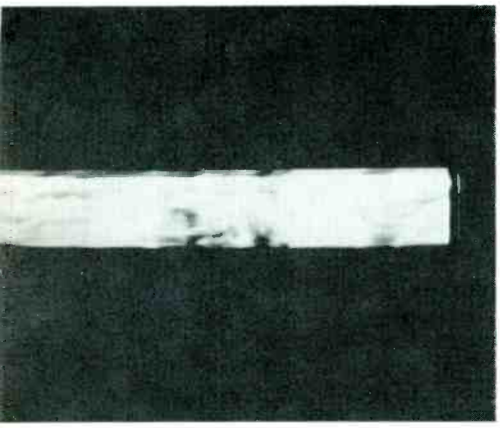


**Fig. 8** An open in R44 or R7 produced a change about once per second from no deflection to an out-of-lock picture 3 inches high.

fect on waveshaping is the same as if returned to ground. However, a low-amplitude parabolic waveform on the cathode prevents R37 from acting as a voltage divider which would reduce the vertical sync pulse.

• **R38** (1—megohm carbon resistor) and **R6** (5-megohm height control)—Total value of these two resistors determines the amount of signal at the plate of the oscillator tube; the smaller the value, the larger the pulse, the higher the plate voltage, and the more height on the screen. On this particular receiver, the total value for best height and linearity was 3 megohms. A change to 2 megohms caused excessive height, the picture rolled down indicating a faster frequency, and the oscillator grid voltage increased to –45. A change to 5 megohms decreased the height 2 inches at the bottom, but without compression or foldover. The grid voltage of the oscillator tube decreased to –30, and the frequency decreased (picture flipped up). Neither resistor is very sensitive to heat or cold.

• **C34** (.033-mfd paper or Mylar dielectric capacitor)—The coupling between the oscillator and the grid of the vertical output tube. A smaller size of .01 mfd reduced the height about 2 inches at the bottom. A .1-mfd capacitor increased the height at the bottom about 1 inch. However, using the .1-mfd value to increase the height and then reducing the height with the height control did not produce as linear a picture as did the normal values.

Leakage of 5.6 megohm produced more height, spread the picture at the top and rolled it down (increased frequency). Leakage of 560K ohms reduced the height at the bottom about 1 inch and produced excessive spreading at the top of the picture. Locking was not possible when the leakage increased to less than 470K ohms.

Because the leakage and capacitance of C34 are critical, it should be a prime suspect when height and linearity are changed by increased heat.

• **R39** (560K-ohm carbon composition resistor)—The DC return for the grid of the vertical output tube. The values of C34 and R39 should be selected to obtain the best linearity at the bottom of the picture. A resistor tolerance of ±10 percent is recommended. R39 is not noticeably sensitive to heat or cold.

• **R44** (150-ohm, 1-watt resistor) and **R7** (750-ohm wire-wound control)—Total resistance of these two determines the amount of DC voltage applied to the cathode. (There is also negative voltage on the grid.) R7 usually is adjusted to produce the best linearity at the top of the picture. Neither resistor is sensitive to heat or cold, nor are their values critical. 34 volts of grid bias produced the least amount of harmonic distortion when a sine wave temporarily was used as a grid signal. But a total grid and cathode bias of 42 volts produced the best sweep linearity. This verifies that a vertical output stage, such as this one, must be slightly overbiased to produce best linearity.

An open in either R44 or R7 caused a change about once per second from no deflection (one horizontal line) to an out-of-lock picture about 3 inches high. (See Fig. 8.) The VTVM voltage reading from cathode to ground was +60 volts. When C3C (discussed next) was disconnected, there was no deflection at any time, and the cathode-to-ground voltage was +55 volts. This proves that the intermittent operation was produced by the charging of C3C. During charging time, the capacitor acted as a cathode resistor, and some sweep was obtained. After the capacitor was charged, the cathode voltage was sufficient to cut off all tube current, and the deflection stopped until C3C discharged back through R37 and the sync circuit, and the cycle was ready to repeat.

• **C3C** (50-mfd section of a multiple-section electrolytic capacitor)—The cathode bypass capacitance, which prevents degeneration and resultant loss of gain. An open C3C decreased the height about 3½ inches and caused some compression at the bottom of the raster and stretching at the top. Fig. 9 shows the effect on scope and picture tube screen of an open in C3C. The amplitude of the waveform is 34 volts PP. Fig. 6, page 61 in the June, 1971, issue of ELECTRONIC SERVICING shows the change from a sawtooth to a parabola by means of filtering. C3C should do the same thing here.

Because C3C is part of a multiple-section can, shorts between sections or a high-resistance in the common lead are possible. To test for either of these possibilities, disconnect the old capacitor and substitute a new one.

• **T1** (laminated-core autotransformer)—This transformer is necessary to match the high impedance of the plate circuit to the low impedance of the vertical yoke windings. A satisfactory replacement transformer should have the same turns ratio and at least as much iron in the core. Shorted turns cause compression, and sometimes foldover, at the extreme top of the picture as shown in Fig. 10. An open in either winding eliminates all vertical sweep.

• **C39** (.1-mfd paper or Mylar dielectric capacitor)—This capacitor is included to prevent horizontal pulses coupled from the horizontal yoke windings to the vertical yoke windings from entering the vertical circuit. In some receivers, horizontal pulses in the vertical circuit can partially cancel alternate vertical sync pulses causing vertical shimmy.

An open C39 caused several black vertical lines in the picture, because the ringing between the horizontal pulses passed through the vertical blanking circuit to the grid of the picture tube.

A value of .2 mfd caused compression and a white line at the top of the picture. A value of .6 mfd produced extreme foldover.

Small amounts of leakage in C39 are not important. For example, a 56-ohm resistor in parallel with C39 reduced the height about 2 inches at the top and bottom and produced foldover at the top.

• **C35** (.015-mfd, 1000-volt paper or Mylar capacitor)—The first coupling and waveshaping capacitance in the positive-feedback path. Internal arcing of this capacitor can cause an effect like vertical shimmy, but the bottom of the picture is affected most.

If C35 is open (except for internal stray capacitance), the picture has only about half height and cannot be locked. A value of .005 mfd caused stretching at the top of the raster. A value of .05 mfd caused a ½ inch decrease at the top and bottom of the raster and only fair linearity. Because over 700 volts PP and almost 300 volts DC are present on the plate side of C35, we recommend a .01-mfd, 1600-volt capacitor be used for replacement.

Leakage in C35 is not critical, but it does cause a loss of height at the bottom and a stretching of the linearity at the top. A parallel resistance of 56K ohms or less prevented locking.

• **R41** (82K-ohm carbon composition-type resistor)—With C35 forms a high-pass filter that removes the sawtooth portion of the waveform. We suspect their action minimizes height and linearity changes that might be triggered by line-voltage fluctuations. The value of R41 is not critical.

• **C36, C37, R42** and **R43**—These components form a low-pass filter which removes any horizontal pulses that were not eliminated by C39, and also reduces the vertical pulse waveform to the amplitude needed at the grid of the oscillator tube. The values of these components are not very critical, nor are moderate amounts of leakage in them.

**Fig. 10** Shorted turns in the windings of the vertical output transformer or a shorted C39 produces compression or foldover at the top and loss of deflection at the bottom of the raster.

An open circuit in R42 or R43 or a near-short across C36 or C37 eliminated the passage of any signal through the positive feedback circuit, and stopped all vertical oscillation.

• **C38** (.01-mfd paper or Mylar dielectric capacitor)—Because this is the main capacitance of the time constant network, it has more effect on frequency than any other capacitor. An open C38 caused a virtual loss of height, and the circuit would not lock. A value of .005-mfd performed equally well as the specified .01 mfd. A value of .0082 mfd is used in other models, and apparently would be a good substitute here. Larger sizes caused a loss of height. A .05-mfd capacitor prevented locking.

Leakage is very critical in C38. For example, a 5.6-megohm leakage caused the picture to roll down (increase of frequency). A parallel resistance of 330K ohms prevented locking.

• **R4** (1-megohm potentiometer)—The vertical hold control and the resistive part of the time constant. For proper locking, the frequency of the vertical sweep circuit should be slightly below normal so that the sync pulse can initiate the start of oscillation. The larger the resistance of R4, the lower the sweep frequency. Best locking is usually obtained if the vertical hold control is turned until the picture rolls down slowly (higher frequency), then the hold control is "backed off" to just beyond the point at which the picture rolls up and "snaps" into lock.

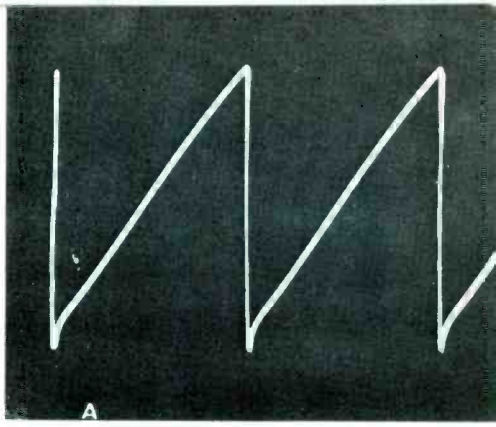




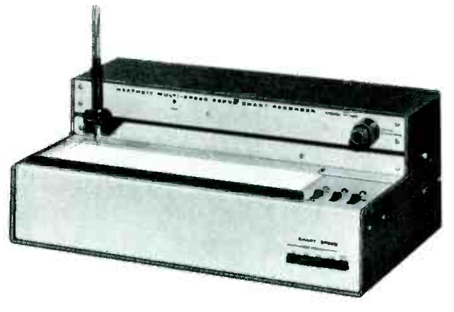
**Fig. 9** An open cathode bypass capacitor changes both the deflection and the waveforms. (A) The sawtooth waveform (34 volts PP) obtained at the cathode of V7B when C3C cathode bypass capacitor was opened. (B) On the screen of the picture tube, an open C3C caused a loss of deflection at the bottom of the raster.

• **R40** (330K-ohm carbon composition resistor)—This resistor performs two functions. One is to prevent the resistance from the grid of the oscillator tube to ground from becoming too low because of a particular setting of the vertical hold control. It is also the lower part of a voltage divider (R4 is the upper part) that furnishes DC voltage to the grid of the output tube. Some sawtooth voltage is present also, but the negative DC voltage is the desired one.

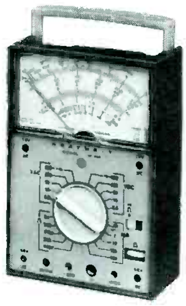
The value of R40 is not critical; a tolerance of ±20 percent should be sufficient.

• **C17** (.01-mfd paper or Mylar dielectric capacitor)—This capacitor couples the vertical blanking pulse to the grid of the picture tube. In addition, the values of C17 and R20 comprise a highpass filter which removes the sawtooth (slanted

IO-102



IR-18M



IM-105

IB-101

IB-102


# New Heathkit® Cost-Cutters

Here's happy news for budget-watchers... a complete new line of Heathkit solid-state test instruments designed to deliver professional performance at traditional Heathkit savings:

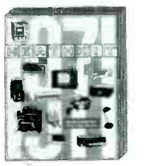
**NEW Heathkit IO-102 5" solid-state scope** delivers DC-5 MHz response... AC or DC coupling...Hi-Z FET input...30 mV/cm sensitivity...continuous sweep rates from 10 Hz to 500 kHz...external horizontal & sync inputs...1 V P-P output... large flat face CRT with 6x10 cm ruled graticule...choice of kit or assembled. **Kit IO-102,** 29 lbs., **119.95*. Assembled IOW-102,** 29 lbs., **179.95***

**NEW Heathkit IM-105 VOM**...8 DC ranges to 5 kV; 7 AC ranges to 5 kV; 6 DC current ranges to 10 A; 5 ohms ranges to x10 k with center scale of 20; 5 dB ranges to +50. High impact Lexan® case & ruggedized taut-band protected meter. Exceptional accuracy. Easy assembly. **Kit IM-105,** 4 lbs., **47.95***

**NEW Heathkit IR-18M solid-state chart recorder**... 12 pushbutton selected speeds... 1 mV or 10 mV full scale... full 10" chart width... 1 second full scale pen response...3-terminal floating input...240 Hz photo-chopper reduces 60 Hz noise. Fast, easy assembly, rapid paper loading. **Kit IR-18M,** 14 lbs., **149.95***

**NEW Heathkit IB-101 solid-state frequency counter**... 1 Hz to over 15 MHz range... 5 digit cold-cathode tube readout...overrange indicator & Hz/kHz switch for 8-digit capability...wide range input without adjustment... low triggering level...1 megohm input...rock-stable time base. **Kit IB-101,** 7 lbs., **199.95***

**NEW Heathkit IB-102 solid-state frequency scaler**...turns virtually any counter into a 175 MHz counter. Scales 100:1, 10:1 or 1:1. Very low triggering level. Easy assembly & operation. Compatible with practically all 1 megohm input counters. **Kit IB-102,** 7 lbs., **99.95***


**FREE '71 CATALOG**

Describes these and over 300 other Heathkits. Save up to 50% by building them yourself. Use coupon and send for your FREE copy!

HEATHKIT

**HEATH COMPANY, Dept. 25-8**
Benton Harbor, Michigan 49022 *a Schlumberger company*

☐ Please send FREE Heathkit catalog

☐ Enclosed is $________, plus shipping.

Please send model(s)________

Name________

Address________

City________ State________ Zip________

Prices & specifications subject to change without notice.
*Mail order prices; FOB factory. TE-244

*Circle 22 on literature card*


## Shop Talk

(Continued)

part of the waveform) from the deflection waveform leaving only the pulse. If this sawtooth is not removed, the top will be darker than the remainder of the picture.

When open, C17 prevented vertical retrace blanking, and diagonal retrace lines were visible during low-contrast scenes. Leakage in C17 increased the brightness. If the leakage has a resistance of less than 330K ohms, the picture will not be blacked out at the minimum setting of the brightness control.

• **R20** (100K-ohm carbon composition resistor)—The DC return path for the grid of the picture tube. When R20 is open, the top third of the picture is darker than the remainder. If the value is too small, vertical blanking will be insufficient.

### Next In Shop Talk

Next month, in part two, troubleshooting methods and tips for servicing vertical sweep circuits will be discussed. ▲


HELP WANTED

Nationwide organization committed to promoting development of minority businesses seeks assistance of like-minded corporations and organizations.

Companies with capital can, in partnership with affiliate of ours, make available as much as $15 in loans to minority enterprises for every $1 they put up. Minimum investment by you: $150,000.

Size no obstacle: General Motors Corporation, I.T.T., Environmental Development Corporation of Bishopville, South Carolina, local and regional Chambers of Commerce already participating.

Talent needed, too. Iowa accountants are counseling minority businessmen on bookkeeping systems and debt management. Stanford University Business School students are studying toward becoming managers of fledgling minority firms on graduation. What can you offer?

Inquiries invited from corporations, organizations, professional associations which can provide such managerial and technical services.

Details on all programs first letter. Reply in confidence to: A. S. Venable, Director, Office of Minority Business Enterprise. United States Department of Commerce, Washington, D.C. 20230.

Space contributed in cooperation with The Advertising Council.

# Tubes Used Most In 1970

## A guide to help you determine shelf and caddy inventories.

Listed here are the 40 tube types which, according to General Electric estimates, were used most in 1970.

These 40 types account for 47 percent of the over 92 million tubes used in 1970. Most of the remaining 53 percent of the total 1970 tube usage was divided among 597 other types, all of which were listed on pages 40 and 41 of the June, 1971, issue of ELECTRONIC SERVICING.

Also shown, for comparison, is the 1969 usage of each tube and the position occupied by that tube in the list of tubes used most in 1969. The asterisk (*) indicates that the tube was *not* included in the list of tubes used most in 1969. □

### Increased Usage

**The following tubes** are either newly introduced types or types whose relative usage has increased significantly.

| | |
|---|---|
| 6GH8A | 12AX7A/7025 |
| 3A3C/3AW3/3B2 | 2AV2 |
| 6JE6C/6LQ6 | 6GY6/6GX6 |
| 6JW8/ECF802 | 6EJ7/EF184 |
| 6HM5/6HA5 | 6KZ8 |
| 6JC6A | 1G3GTA/1B3GT |
| 6KT8 | 6DX8/ECL84 |
| 6BL8/ECF80 | 6LB6 |
| 6JU8A | 17JZ8 |

### Decreased Usage

**The following types of tubes** either were on the 1969 tubes-used-most list and do not appear on the 1970 list, or do appear on the 1970 list but their usage has decreased significantly.

| | |
|---|---|
| 6AX4GTB | 6EM7/6EA7 |
| 12BY7A/12BV7/12DQ7 | 12BA6 |
| 6BZ7/6BQ7A | 5U4GB/5AS4A |
| 3AT2 | 35W4 |
| 6SN7GTB | 6CB6A/6CF6 |

| Type | 1970 Usage | 1969 Usage | 1969 Position |
|---|---|---|---|
| 1. 6GH8A | 6,810,000 | 3,650,000 | 1. |
| 2. 6FQ7/6CG7 | 2,360,000 | 2,950,000 | 2. |
| 3. 6CJ3/6DW4B/6CL3 | 2,280,000 | 2,390,000 | 3. |
| 4. 3A3C/3AW3/3B2 | 2,210,000 | 1,200,000 | 8. |
| 5. 6JE6C/6LQ6 | 2,020,000 | 1,330,000 | 7. |
| 6. 6BK4C/6EL4A | 1,910,000 | 1,700,000 | 5. |
| 7. 6EA8 | 1,630,000 | 1,710,000 | 4. |
| 8. 6GF7A | 1,180,000 | 950,000 | 15. |
| 9. 6JW8/ECF802 | 1,100,000 | * | * |
| 10. 6JS6C | 1,020,000 | 1,060,000 | 11. |
| 11. 6BZ6 | 990,000 | 1,050,000 | 12. |
| 12. 6AQ5A/6HG5 | 920,000 | 1,170,000 | 9. |
| 13. 5U4GB/5AS4A | 900,000 | 1,490,000 | 6. |
| 14. 6DQ6B/6GW6 | 900,000 | 1,170,000 | 10. |
| 15. 6HM5/6HA5 | 880,000 | 500,000 | 34. |
| 16. 8FQ7/8CG7 | 880,000 | 730,000 | 24. |
| 17. 50C5 | 860,000 | 1,040,000 | 14. |
| 18. 6JC6A | 850,000 | 550,000 | 31. |
| 19. 6CG8A | 830,000 | 910,000 | 17. |
| 20. 6GU7 | 830,000 | 720,000 | 25. |
| 21. 6AW8A | 790,000 | 830,000 | 20. |
| 22. 6KT8 | 780,000 | * | * |
| 23. 6BL8/ECF80 | 760,000 | * | * |
| 24. 6JU8A | 740,000 | 500,000 | 35. |
| 25. 6U8A/6AX8/6KD8/5KD8 | 740,000 | 930,000 | 16. |
| 26. 6EW6 | 660,000 | 630,000 | 26. |
| 27. 12AX7A/7025 | 650,000 | * | * |
| 28. 2AV2 | 640,000 | * | * |
| 29. 1V2 | 620,000 | 570,000 | 29. |
| 30. 6GY6/6GX6 | 610,000 | 480,000 | 36. |
| 31. 6EJ7/EF184 | 600,000 | * | * |
| 32. 6KZ8 | 600,000 | * | * |
| 33. 1G3GTA/1B3GT | 560,000 | * | * |
| 34. 35W4 | 540,000 | 900,000 | 18. |
| 35. 6AU6A | 530,000 | 760,000 | 21. |
| 36. 6DX8/ECL84 | 530,000 | * | * |
| 37. 6CB6A/6CF6 | 520,000 | 1,050,000 | 13. |
| 38. 12BE6 | 510,000 | 530,000 | 33. |
| 39. 6LB6 | 500,000 | * | * |
| 40. 17JZ8 | 500,000 | * | * |

▲

# SOLID-STATE AUDIO

# A Review of the Latest Circuitry and General Troubleshooting Procedures

by Joseph J. Carr

### Methods of Biasing

One of the most important aspects of servicing solid-state audio is an understanding of the methods used to achieve proper biasing of the transistors.

#### Common methods

By now, most of us are familiar with the more-or-less standard transistor biasing arrangements. A few of these are shown and explained in Fig. 1. These circuits, or variations of them, are used in most types of solid-state audio equipment.

#### Dual-Supply Method

A biasing circuit that is not so universally recognized but is being used more is the dual-supply design shown in Fig. 2. It can be identified

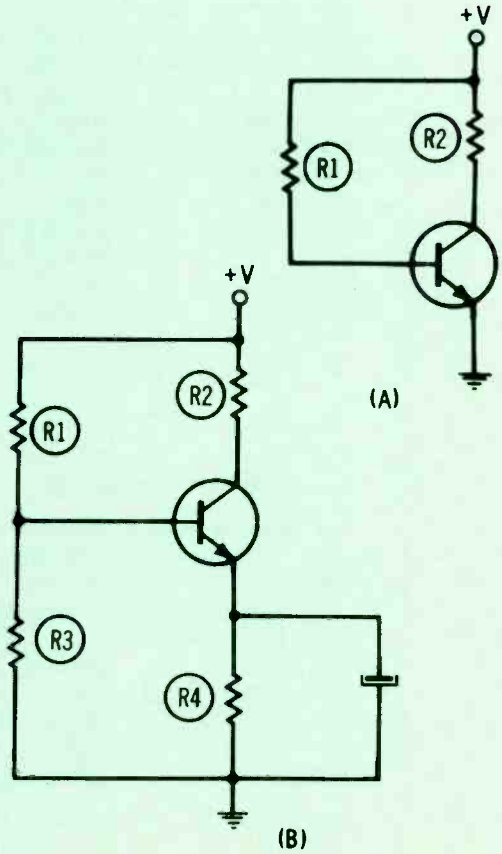



**Fig. 1** Common methods of biasing transistors.
A) **Fixed-Base-Current Bias**—This is the simplest of all bias arrangements, and the most impractical. Bias is established by current flow from the emitter-base junction of the transistor through R1 to the supply voltage. The amount of bias is dependent on the value of R1 and the supply voltage. The primary disadvantage of this bias arrangement is that it provides no means of automatically limiting collector current (stabilization).
B) **Collector-Feedback**—A simple form of self-bias. Because R1 is connected to the transistor side of load resistor R2, any change in collector current will cause a proportional but opposite change in transistor bias. For example, if collector current increases because of a temperature increase, the voltage at the collector decreases (becomes less positive), which, in turn, reduces the current through the circuit comprised of the emitter-base junction and R1. Although this bias system does provide a degree of stabilization, it also introduces degeneration, caused by feedback of any AC signal voltage developed across the load resistor.
C) **Collector-Feedback With AC Bypassing**—This is the same bias system described in (B) except an electrolytic capacitor has been added to filter out, or bypass, AC variations.
D) **Combination Fixed and Self-Bias**—This configuration provides both good stabilization and minimum degeneration. The fixed emitter-base bias is developed by the voltage divider consisting of R1 and R3. Usually, the valve of R3 is substantially less than that of R1. Resistor R4 performs the function of stabilizing the transistor. For example, if emitter-to-collector current increases because of an increase of temperature, the voltage drop across R4 also increases, placing a more positive voltage on the emitter, which reduces the forward bias on this NPN transistor. The capacitor bypasses AC variations around the emitter resistor, to prevent degeneration. The value of R4 usually is five to ten times less than that of R3.

by the fact that the ground (or common, if you prefer) is not returned to the positive or the negative side of the power supply. (The circuit in Fig. 2B is a power supply that typically is used with the dual-supply type of amplifier.). Instead, in most applications, the ground, which is usually the chassis, "floats" at the electrical mid-point of the two supplies. (However, it sometimes is designed "closer" to one side than the other, although it usually isn't in audio equipment, because this limits the swing of the output voltage waveform).

Increased output voltage swing is one of the advantages of the dual-supply circuit. Another advantage seems to be improved thermal stability. This can mean a lot in an amplifier that has marginal heat-sinking or that is used inside a closed cabinet. A third advantage is that these circuits tend to be less sensitive to hum pick-up caused by power-supply ripple.

#### Darlington pair

Another type of circuit that is being used more often in solid-state audio equipment is the Darlington amplifier, also called the Darlington pair. An example of this configuration is shown in Fig. 3A. Notice that the collectors of the two transistors are tied together. Also note that the emitter of the input transistor is tied directly to the base of the output transistor. This produces higher current gain and a much higher range of input impedances than are normally possible with bipolar transistors.

Although any two properly selected transistors can be used to make a Darlington pair, it has been the practice of several semiconductor producers to make such pairs available in one package. Both integrated-circuit types and dual-transistor types are available. RCA's type CA3036 integrated circuit consists of two Darlington pairs that have **all** of their collectors tied together. The internal schematic of the CA3036 is shown in Fig. 3B.

### Power Amplifier Designs

#### Single-ended, transformer-coupled

One of the oldest designs of solid-state power amplifiers is the single-ended, choke- or auto-former-

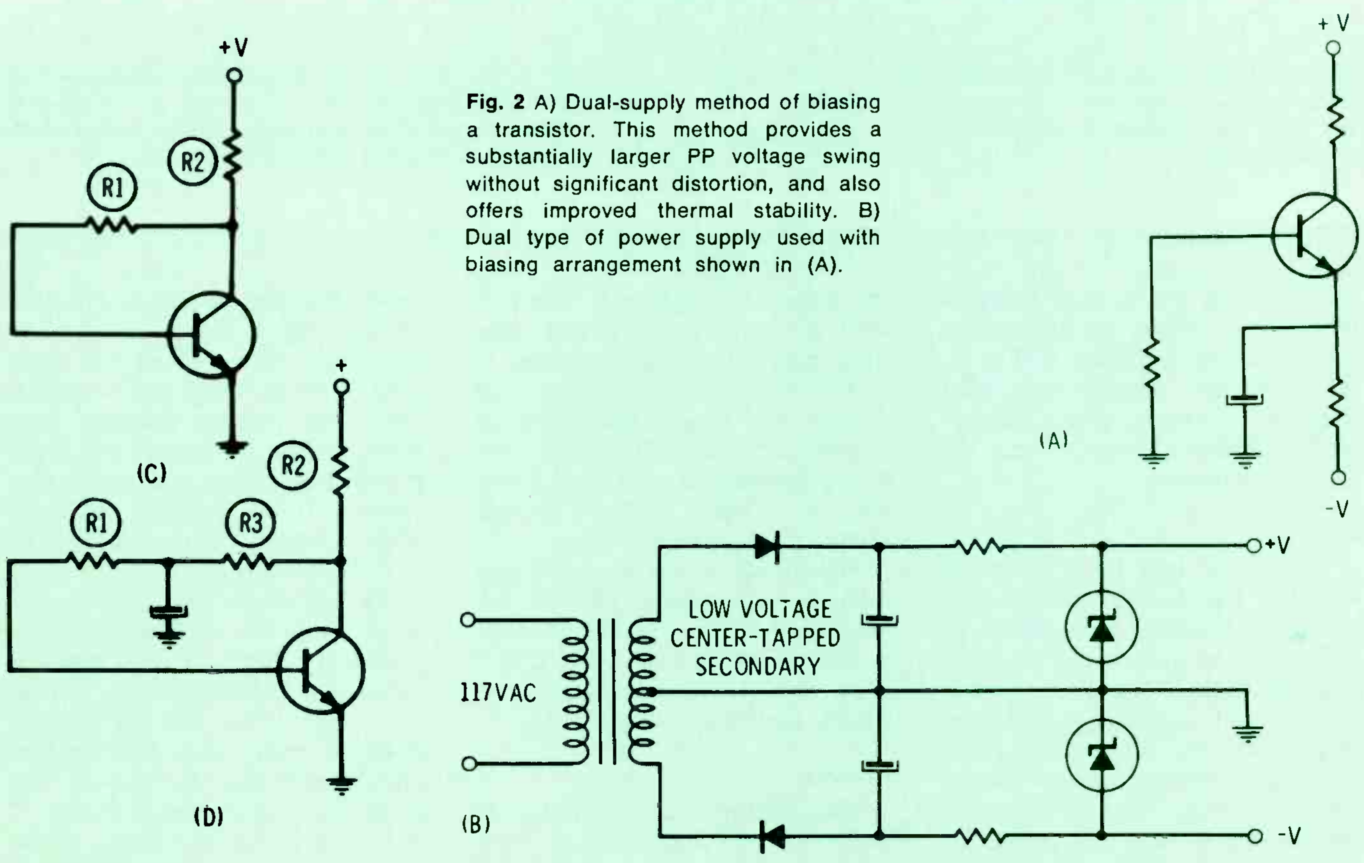



**Fig. 2** A) Dual-supply method of biasing a transistor. This method provides a substantially larger PP voltage swing without significant distortion, and also offers improved thermal stability. B) Dual type of power supply used with biasing arrangement shown in (A).

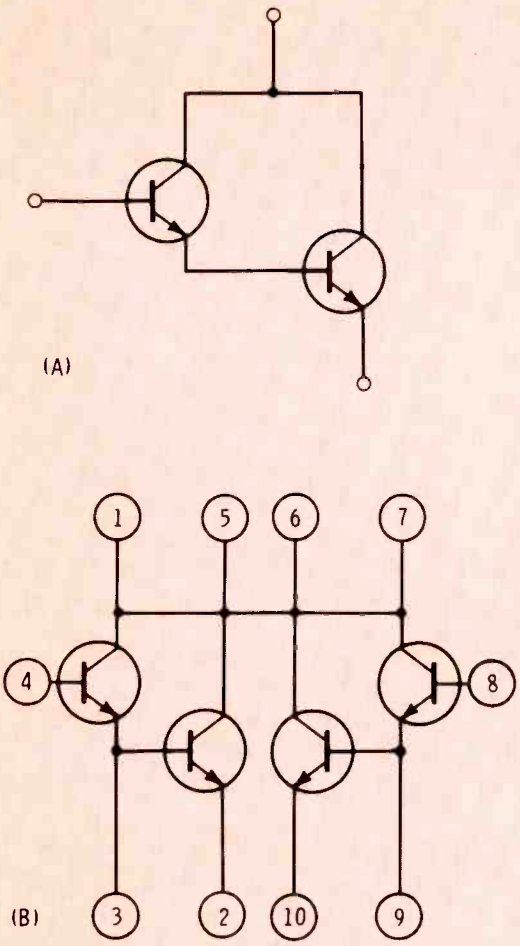



**Fig. 3** Darlington amplifiers. A) Conventional Darlington pair. B) Two Darlington pairs tied together in an RCA integrated-circuit.

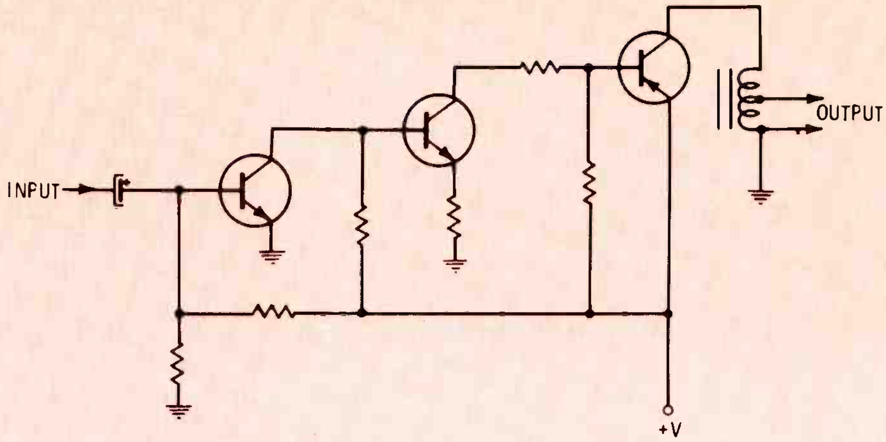



**Fig. 4** Single-ended, autotransformer-coupled power amplifier stage without feedback. Distortion is primary disadvantage of this type of power amplifier.

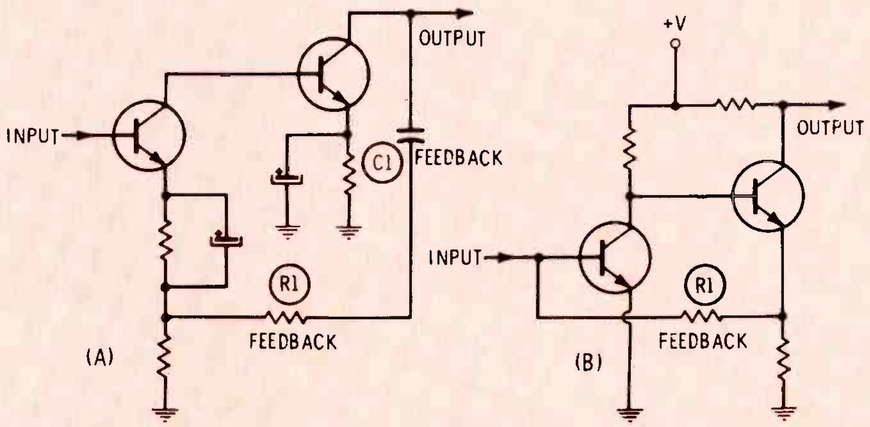



**Fig. 5** Two basic types of feedback circuits used in solid-state audio systems. A Second collector-to-first emitter system. B) Second emitter-to-first base system. Feedback reduces or eliminates distortion.

coupled type, which, even today, is used in car radios. An example of such a circuit is shown in Fig. 4. By itself, this amplifier can offer little in the way of decent fidelity. Add feedback, however, and the situation changes.

#### Feedback

There are two basic kinds of feedback circuits normally used in consumer products. One, shown in Fig. 5A, is called the "second collector-to-first emitter" system. With correct values of components, this circuit can make a relatively mediocre amplifier sound like a more expensive one. An open or shorted capacitor or a change in the value of a resistor in this network will create problems that range from mildly irritating distortion to a runaway condition which can destroy the output transistors. A step-by-step check of feedback components should be performed whenever a "strange" set of trouble symptoms is encountered.

Fig. 5B shows the second widely used feedback system. This one has been dubbed the "second emitter-to-first base" system. This circuit often employs only one resistor to supply feedback voltage.

#### Push-Pull

The push-pull circuit is widely preferred over other types, for both power-handling ability and overall fidelity. Fig. 6 shows the standard push-pull circuit which has been used in almost every audio application, from 5-dollar portable transistor radios to relatively high-priced auto radios and stereo tape players. It is, however, far from efficient when compared to circuits of more recent design.

The circuit in Fig. 7 is a more recent addition to the family of push-pull amplifiers. It often is called the "split-secondary, totem-pole" circuit, and is used in many domestic and imported radios, phonographs and tape players. The particular circuit shown in Fig. 7 is from a Motorola console stereo, Chassis HS-2338. The series connection of the output transistors and the split-secondary interstage transformer are the two main identifying features of this circuit.

One thing that all push-pull amplifiers have in common is the necessity of phase-splitting the input signal to provide two signals 180 degrees out of phase to drive the two halves of the push-pull circuit. In older designs, this was accomplished by either a center-tapped or split-secondary interstage transformer. In many modern designs, the interstage transformer is left out. Although this reduces cost, it does little for fidelity, unless some other means of phase splitting is used.

The transistor phase inverter is one possible replacement for the transformer. These circuits are very similar to their tube counterparts. They have one driving signal taken from the collector circuit and another, of opposite polarity, taken from the emitter, as shown in Fig. 8.

Another method of providing drive signal of opposite polarity is to use an integrated-circuit preamplifier which has both inverted and non-inverted outputs. Such units provide push-pull, wide-band outputs from a common input signal. An example of such a circuit is shown in Fig. 9.

Designers have another method of accomplishing phase inversion that often is more economical than either of the methods mentioned above. It is a circuit called the "complementary symmetry" amplifier. This design, shown in simplified form in Fig. 10, takes advantage of the fact that PNP and NPN transistors require signals of opposite polarity to perform the same function. Notice that the bases of the two output transistors are fed in parallel and that the speaker, minus the output transformer, is connected to the midpoint of the two series transistors. Versions of this circuit which use a single asymmetrical power supply usually employ a capacitor to block DC from the speaker circuit. Dual-supply amplifiers might or might not use such a capacitor.

Complementary symmetry circuits do have a disadvantage: It is difficult to locate matched PNP and NPN transistors. Manufacturers "spec" sheets reveal that there are only a few types that can be paired up for complementary service. As the amplifier's power level requirements increase, the number of types from which the designer can choose decreases drastically. The problem becomes even more acute when selecting replacements for such transistors.

It is relatively easy to find matched pairs for low- and medium-power complementary circuits. Such circuits are used widely in phonographs, stereo tape players, auto radios and low-power stereo amplifiers. It is even relatively easy to find matched pairs in universal replacement lines, if the power requirement is only a few watts.

This has led to an interesting modification of the complementary symmetry circuit. The circuit shown in Fig. 11 employs what is known as the quasi-complementary configuration. In this circuit, the outputs are "totem pole" and the drivers are complementary. For the designer, this means a larger selection of possible power transistors. For the servicer, it means use of a lower-priced line of replacements (less matching necessary).

Complementary and quasi-complementary circuits can provide the technician with a new bundle of headaches, if certain precautions are not followed. For example, these amplifiers have some characteristics similar to those of RF amplifiers. One common characteristic is the wide frequency response required of the transistors used for amplification. Because all of these amplifiers are fed very low levels of input signal, extremely high gain is required.

**Fig. 6** Conventional push-pull power amplifier. The two input signals of opposite phase required by push-pull design are provided this circuit by transformer action.

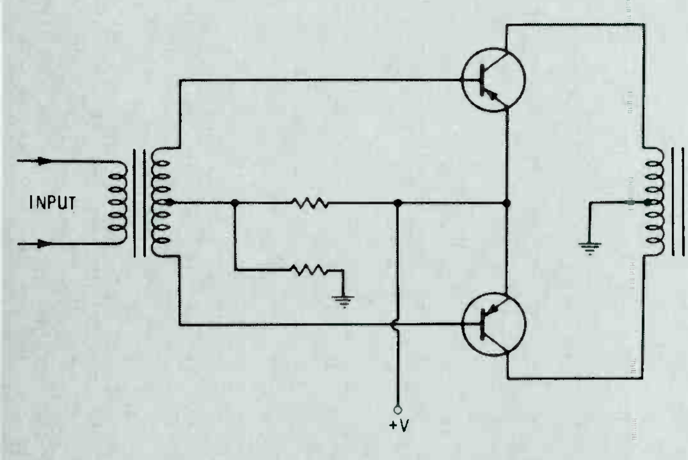
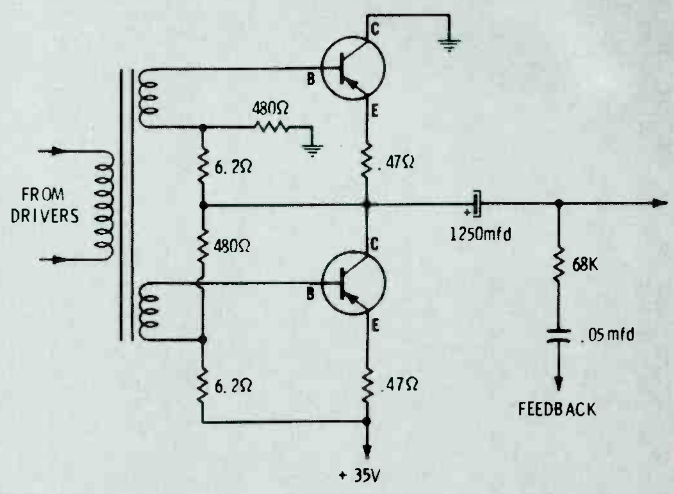



**Fig. 7** More recent design of push-pull amplifier used in Motorola HS-2338 stereo chassis.



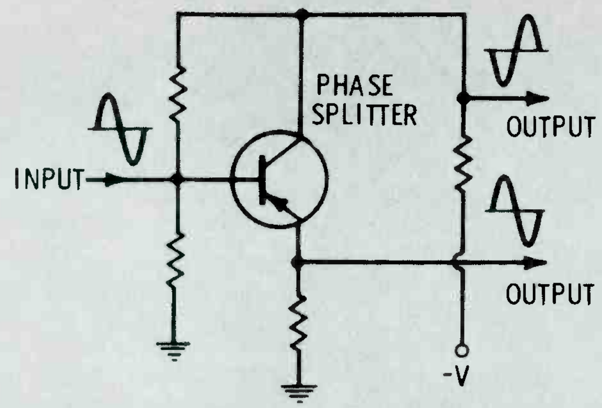



**Fig. 8** Phase inverter, which provides two signals of equal amplitude but opposite phase, replaces interstage transformer between driver and push-pull output stages in some audio amplifiers.

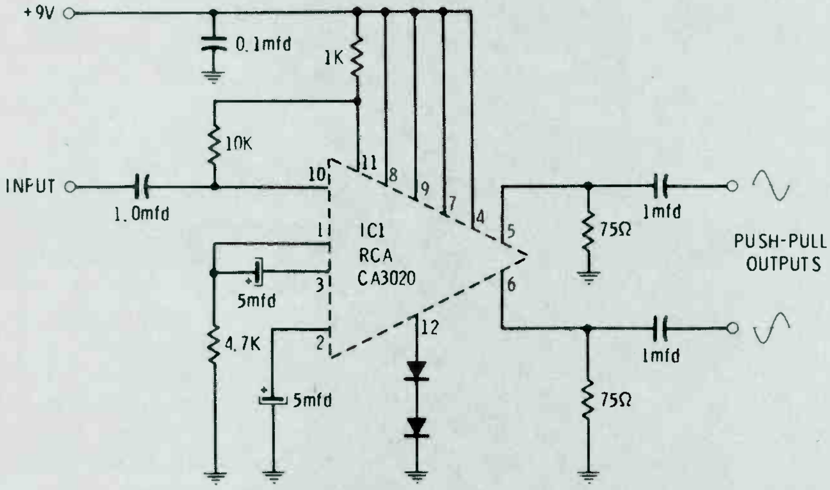



**Fig. 9** Equal but opposite drive signals required by push-pull circuit also can be obtained from an integrated-circuit preamplifier which provides inverted and non-inverted outputs.

High-frequency transistors in high-gain circuits are quite capable of oscillating at an RF range that extends from supersonic audio to VHF. The result can be a high level of distortion, "lisping", etc. A square-wave test of the amplifier usually will reveal whether ringing or other types of oscillation are present. The visual indication on the oscilloscope screen will be either ringing or a blurring of the trace. Such oscillations can be caused by open capacitors, incorrect replacement transistors or improper lead dress.

### General Troubleshooting Techniques

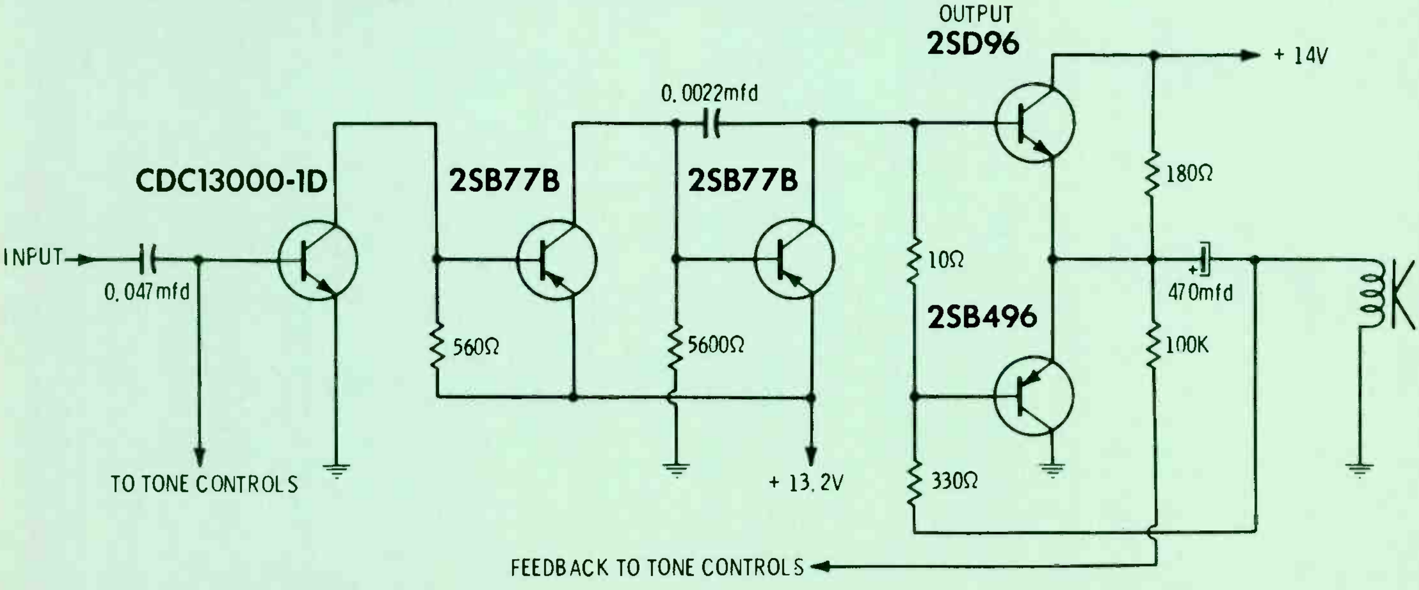
Most technicians agree that the newer circuits are more difficult to service than some of the older designs.

One reason is that many of the newer circuits are direct-coupled. Another reason is complexity of design.

Most troubles, however, can be located within a reasonable time if the technician establishes a routine, logical system of diagnosis.

The first step is a preliminary inspection using sight, sound, smell and touch. Notice, for example, whether any fuses are open or if

**Fig. 10** Complementary symmetry amplifier is a push-pull design which eliminates the need for two separate input signals. See text for detailed explanation of operation.



any fuse resistors show signs of overheating. On many sets, the leads to the emitters of the output transistors serve as fusistors. Notice whether their insulations are charred or melted. Also note whether the printing on any of the output transistors has been erased by heat. This could indicate which of several transistors is shorted. A transistor that heats up before shorting can often be detected by touch. I occassionally touch several transistors in a single affected section to determine if any of them are heating quicker than the others.

Shorted and leaky transistors cause a large percentage of the difficulties encountered in solid-state power amplifiers. One way to locate defective transistors is to measure bias and supply voltages with a VTVM. Generally speaking, though, such tests will confirm only what visual evidence already indicates (burned fuse resistors, etc.).

Locating a suitable replacement transistor might take more time than the actual diagnosis. A good rule of thumb is to replace a transistor with an identical type, if the only substitute is from a so-called "universal" line. This advice, in many cases, also applies to using a direct replacement from a manufacturer other than the original.

Always be over-cautious about substitutes. After wading through several large stacks of transistor substitution guides, I have concluded that, in many instances, the people who compile the guides do not even look at the cases of the transistors, much less actually test them. In one incident, I was supplied with a transistor in a small TO-5 case which, according to the substitution guide, was supposed to replace one in the much larger TO-3 diamond case. Because of the inherent mounting difficulties, there would have been heat dissipation problems. Another time, I was sent a drift-field PNP oscillator/RF amplifier transistor to replace an NPN audio unit. All of these examples involved transistors selected from the replacement guide published by a leading transistor supplier. Because of these difficulties, I always carefully read the catalogue description of the recommended replacement. If it doesn't meet the most critical characteristics of the original transistor, I do not order it.

Remember, it is no longer true that a mere handful of universal numbers will replace virtually every transistor you will encounter.

Improper heat sinking of the replacement transistor is one of the most persistent causes of premature failure. This causes profit-robbing callbacks, which don't do anyone any good. Careful tightening of the mounting screws and the use of an approved silicone heat-sinking grease will eliminate most heat-sink problems. The mounting screws are especially important on epoxy case power transistors, which recently have become popular in auto radios, phonos and table-model radios. Many technicians do not make these screws tight enough because they fear cracking the case.

Defective output transistors often cause distortion accompanied by low volume. One way to spot this defect is to measure the DC voltage at the junction where the two output transistors and the output capacitor are connected together. Compare this voltage to the overall supply voltage feeding that series chain. In most circuits, it should be close to half the total supply voltage. If it is significantly higher or lower, suspect one or both of the transistors.

Unfortunately, many types of distortion are not so simple to locate. In many instances, a small transistor defect in a pre-driver stage will cause massive bias changes on the output transistors. The complication of DC feedback compounds the difficulty of diagnosing such a defect. A harmonic distortion analyzer can be useful in such situations.

The power ratings on some modern amplifiers are confusing because the meaning of "watts" seems to vary from manufacturer to manufacturer. The load impedance of late-model audio amplifiers is often listed along with the power rating. You might encounter a specification of "fifty watts into four ohms". Such stipulations are necessary because the load (speaker) impedance is more dependent on the overall operating parameters than was formerly the case.

Short circuiting the output, or, in some cases, open circuit conditions, sometimes can damage the output transistors. Consequently, be certain that the correct speaker or dummy load is used. ▲

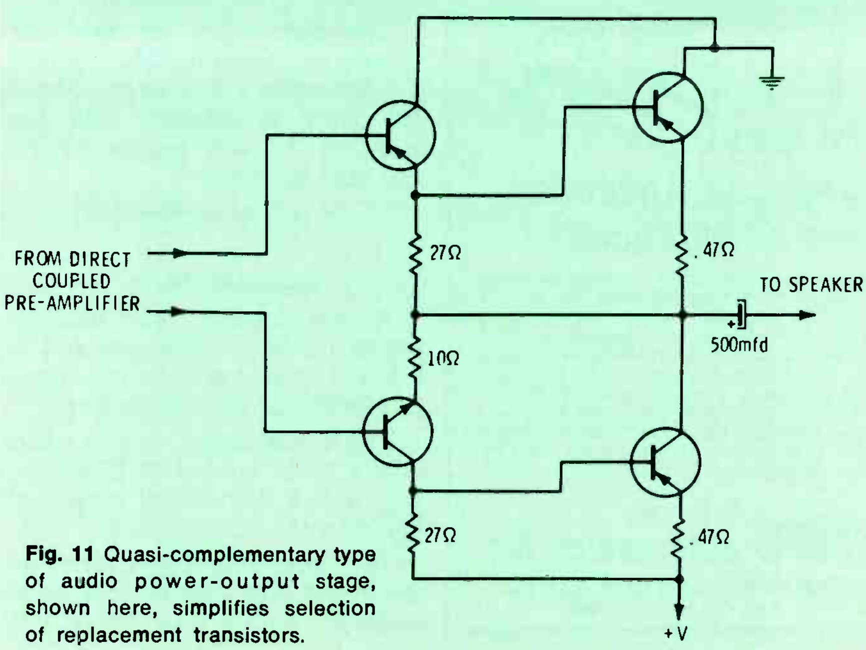
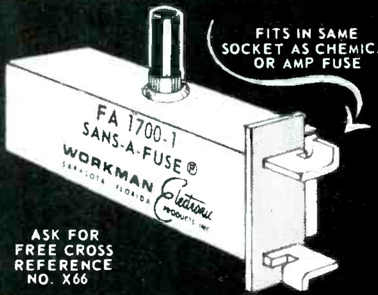



**Fig. 11** Quasi-complementary type of audio power-output stage, shown here, simplifies selection of replacement transistors.

A **PROVEN** IMPORTANT DEVELOPMENT FOR TV SERVICING

14 MODELS

**SANS-A-FUSE®**




COLOR CODED CIRCUIT BREAKER REPLACEMENT FOR CHEMICAL OR AMP FUSE

•

SAVES TIME AND FUSES WHEN LOCATING SHORTS IN TELEVISION CIRCUITS

•

DEVELOPED AND MANUFACTURED BY

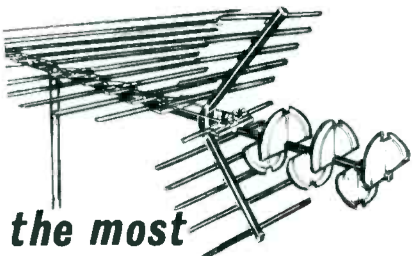
WORKMAN Electronic PRODUCTS, INC.

P.O.BOX 3828 SARASOTA, FLORIDA 33578

*Circle 23 on literature card*

**"STAR-TRACK"**

***SPACE-AGE VHF/UHF/FM COLOR ANTENNAS FOR ALL AREAS!***



***the most Advanced Antennas ever introduced!***

Similar design to Space Tracking Antennas! Combines the "Corner Reflector Disc Director Array" for total UHF coverage, with "Multiple Tuned, Cut-to-Channel, VHF Elements for unsurpassed Color and Black and White TV! Includes VHF/UHF Splitter for economical single down-lead installation. Licensed under U.S. Pat. No. 3,440,658 of Richard D. Bogner, the designer of many Antennas used in the Space Program! 6 Antenna models for all areas—write for FREE illustrated specification brochure.

**RMS ELECTRONICS, INC.**

50 Antin Place, Bronx, N.Y. 10462
Tel. (212) 892-6700

*Circle 24 on literature card*

# test equipment report

### Volt-Ohm-Milliammeter

A VOM which measures AC (RMS) or DC voltage from 0.1 to 1,000 volts in four ranges, DC current from 10 microamperes to 250 milliamperes in three ranges, and resistance from one ohm to 200 kilohms in two ranges has been introduced by RCA Electronic Components.


AC and DC sensitivity of the instrument is said to be 2,000 ohms per volt.

Pin-jack connectors are utilized for various functions and ranges, according to the manufacturer.

The unit weighs less than one pound, and measures 2¾ inches x 4 5/16 inches x 1⅜ inches. Model WV-516A is supplied with test leads, a 1.5-volt penlite battery and sells for $9.95.

*Circle 50 on literature card*

### Megohm Meter

A new megohm meter used for testing insulation resistance and as a hi-pot tester has been introduced by Hochheiser Electronics Corp.

The circuit design reportedly permits a probe voltage of 1200-volts DC, with a short-circuit current of less than 0.5 milliamperes.

The only control is a press-to-test button. The scale range is 0-100 megohms, with a total power con-


sumption of less than 10 watts at 115-volts AC, 50-60 Hz, reports the manufacturer.

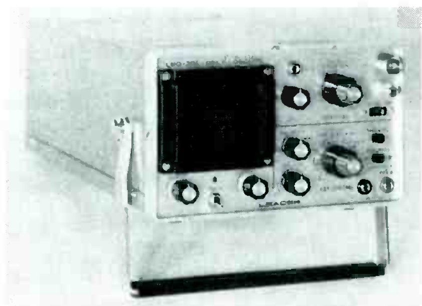
The Model A-102 megohm meter sells for $139.50.

*Circle 51 on literature card*

### Three-inch Triggered Scope

A solid-state, portable, three-inch triggered-sweep oscilloscope/vectorscope is offered by Leader Instruments Corp.

Model LBO-301 features both vertical and horizontal calibration, according to the manufacturer. Other features include: 5X magnification, with a maximum speed of 0.2$\mu$s/cm; sweep speeds of 1 $\mu$s to 50ms/div, in 15 ranges; preset TV-H and TV-V positions; vertical



bandwidth of DC to 7 MHz; and a rise time of 70 nanoseconds. A 0.5-volt p-p calibrated square-wave voltage and a vertical sensitivity of 10-millivolt p-p to 5-volts p-p/div in 9 ranges are also included in the design of the scope.

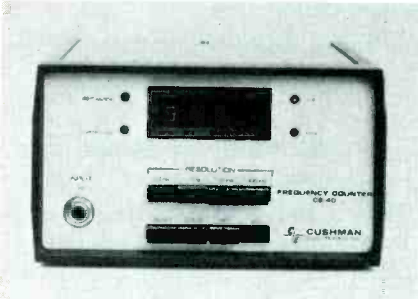
The scope weighs 14 lbs., measures 4¾ inches x 8 inches x 12 inches, and sells for $334.50.

*Circle 52 on literature card*

**Frequency Counter**

A new, 1-MHz general-purpose frequency counter which performs low-frequency measurements by the use of times-two multiplication of input frequency on 1 Hz and 0.1 Hz time bases, has been introduced by Cushman Electronics, Inc.

Features of the Model CE-40 include: 4-digit, solid-state LED readouts; built-in recharger; front panel



recharge indicator; internal crystal oscillator standard; and four selective time bases.

The CE-40 measures 3⅞ inches x 6¾ inches x 9¼ inches and weighs 8 pounds and reportedly operates on AC or internal batteries.

Model CE-40 sells for $495.00.

*Circle 53 on literature card*

**Torque Tester**

A new instrument which measures the torque required to wind the tape in any digital or audio cassette has been introduced by Information Terminals Corp.

Designed to aid in servicing cassette drives, incoming inspection of new cassettes, and reinspection of used cassettes, the M-200 Torque Tester reportedly is calibrated to display torque in gram-centimeters and ounce-inches.

Application is as follows: place a cassette on the instrument's deck and press the "start" button; winding torque of the cassette is continuously indicated on the meter, according to the manufacturer.

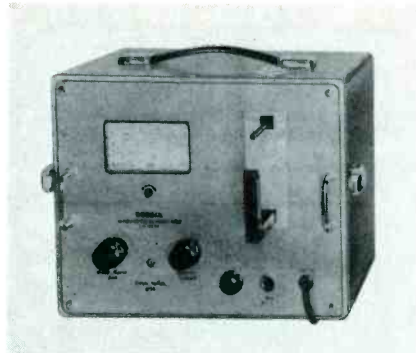
An 8-gram-centimeter holdback torque may be switched in and out with a lever. Power is provided by alkaline cells with a reported 600-hour service life. Price is $250.00.

*Circle 54 on literature card*

**Shorted-Turns Tester**

A high-sensitivity instrument which will detect the presence of one or more shorted turns in a coil using up to No. 44 wire has been announced by Freed Transformer Co., Inc.

The shorted-turns tester, Type



1801-20101, will reportedly test most types of audio, power and IF

*(Continued on page 46)*


# HERE'S YOUR OPPORTUNITY
## TO SUBSCRIBE TO
# RCA SERVICE DATA
COVERING CURRENT MODEL RCA CONSUMER ELECTRONIC PRODUCTS

A SUBSCRIPTION INCLUDES A COMPLETE "FILE" YEAR OF:

- COLOR TELEVISION DATA
- B & W TELEVISION DATA
- RADIO DATA
- PHONOGRAPH DATA
- TAPE RECORDER DATA
- SERVICE TIPS
- PARTS TIPS
- PERIODICAL ISSUES OF "PLAIN TALK"
- "GOLDENROD" BULLETINS

*DON'T DELAY!*

ORDER YOUR SUBSCRIPTION

***TODAY!***

Please acknowledge my request for a Service Data Subscription:

☐ "File—1971" Service Data including 2 binders $19.95
☐ "File—1971" Service Data subscription $14.95
☐ (Binders available separately—$2.95 each) Number desired ______

Amount enclosed: $________

NAME ______________________

STREET ADDRESS ______________________

CITY ____________ STATE ____________ ZIP CODE ____________

● Your order will be processed promptly upon receipt of your check or money order in the amount indicated above. SEND TO:
**RCA SALES CORP., 600 N. Sherman Drive, Indianapolis, Ind. 46201**
**ATTN: Technical Publications, 8-106.**

*Circle 25 on literature card*

NEW ENDECO
# Desoldering Kits

MODEL 300-K KIT SHOWN

**All you need to handle almost any desoldering and resoldering job!**

Kit 300K includes the famous Endeco pencil desoldering iron Model 300, six different size tips (.038 to .090) for any job, tip cleaning tool, and metal stand for iron . . . all in a handy lifetime steel storage box. $19.90 net. Model 300K-3 with a 3-wire cord $20.90. Also a similar kit for military users. Kit 100K with large Endeco iron (Model 100A) is $27.40, and 3-wire Kit 100AD-3 $28.40.

SEE YOUR DISTRIBUTOR OR WRITE

ENTERPRISE DEVELOPMENT CORPORATION
E. 65th St., Indianapolis, Ind. 46220

*Circle 26 on literature card*

# KEEP 'EM QUIET...
**and CLEAN 'EM, TOO . . .**
**with QUIETROLE**


When you use Quietrole, you can be sure of clean, quiet operation, because you are using the number one cleaning and lubricating spray pack available. Safe for any set, color, or black and white. Absolutely no harmful aftereffects of any type.

*In bottles too, if you prefer.*

***QUIETROLE** . . . the choice of better servicemen everywhere.*

Product of
**QUIETROLE COMPANY**
Spartanburg, South Carolina

*Circle 27 on literature card*

transformers, chokes, relays and other coreless coils. A low-frequency, built-in oscillator reportedly minimizes Eddy current losses.

Type 1801-20101 measures 11 inches x 9 inches x 10 inches and weighs 13½ pounds, with a power requirement of 115 volts, 60 Hz, according to the manufacturer.

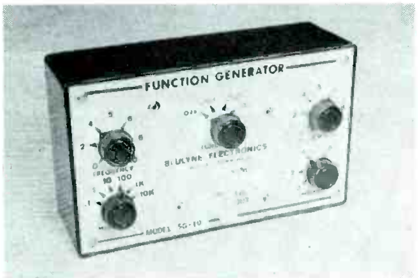
The unit is priced at $395.00.

*Circle 55 on literature card*

### Function Generator

Blulyne Electronics Corp. has announced the Model SG-10 Function Generator.

Features of the Model SG-10 generator reportedly include: an ultra linear ramp, square wave, and pulse with adjustable pulse width from 0-100% duty cycle.



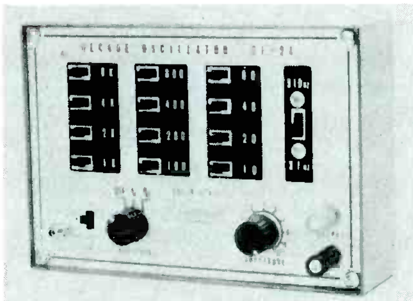

The frequency range is 0.1 Hz to 100 KHz. The unit reportedly is equipped with variable amplitude, frequency and pulse width controls. Rise times are less than 200 nanoseconds, according to the manufacturer.

Price of Model SG-10 is $69.95.

*Circle 56 on literature card*

### Sine/Square-Wave Generator

A transistorized sine/square-wave generator, Model DF-24, has been introduced by the Electronic Tools Division of C. H. Mitchell Co.



Frequency range, in three bands, is 10 Hz to 166.5 KHz for sine waves, 20 Hz to 20.0 KHz for square waves. The frequency accuracy for sine and square waves is 1% + 1 Hz, according to the manufacturer. Output signal amplitude reportedly is controlled by a variable attenuator with high resolution. Power is furnished by penlight batteries.

The DF-24 measures 7 inches x 3 inches x 5 inches and weighs 2⅓ pounds. Because no external source is needed, the unit can be used anywhere.

Model DF-24 sells for $65.00.

*Circle 57 on literature card*

### AC Millivolt Meter

Model LMV-87A AC Millivolt Meter, just introduced by Leader Instruments, measures AC voltages from 1 mV to 300 volts, and decibels from −60 to +50.

The frequency response of this solid-state meter is 10Hz to 1MHz. A regulated DC power supply is incorporated, and the input impedance is reportedly very high to minimize loading of the circuits under test.

The LMV-87A may be used to measure the voltage output of phonograph cartridges and tape heads


or the hum and noise of amplifiers. It is reported the meter can be used as a wide-band preamplifier for use with an oscilloscope.

Complete with a carrying strap, the LMV-87A measures 8 inches x 6 inches x 4¾ inches and weighs 5½ pounds.

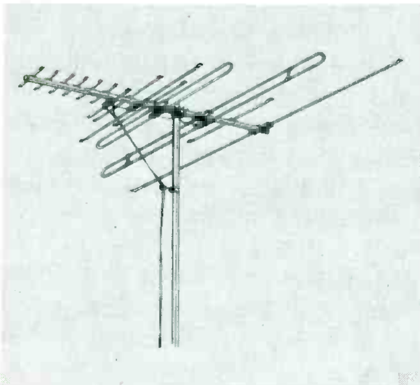
Model LMV-87A sells for $124.00. ▲

*Circle 58 on literature card*

# antenna systems report

### TV Antenna

Antenna Corporation of America announces its new "Brand X", Model AC-802 TV antenna, with band separator and 96-inch boom, for VHF/UHF black-and-white or



color TV and FM reception.

"Brand X" reportedly is equipped with all-aluminum elements, high-impact insulators and crush-proof mast clamps and features snap-out elements and a gold finish.

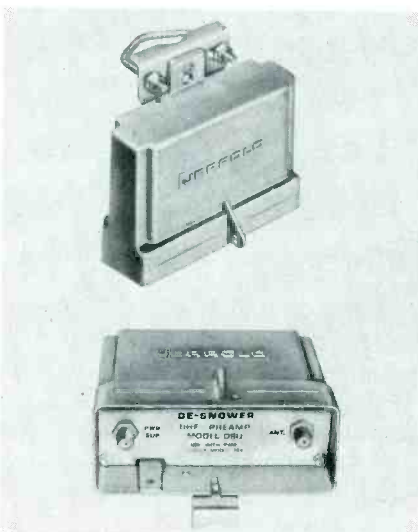
This antenna sells for $26.95.

*Circle 60 on literature card*

### UHF "De-Snower"

Model DSU-105 is a high-gain, low-noise, 75-ohm (in and out) preamplifier, described as a de-snower device for channels 14 through 83.

The DSU-105, announced by Jerrold Electronics Corp., employs




"stripline" constructed transistors with low radial lead inductance, which reportedly reduces noise over the entire UHF band, 470-890 MHz.

Specifications include:

- Gain—470-800 MHz: 26 dB
- Flatness of Response—±1.25 dB
- Noise Figure—470 MHz: 6.5 dB; 800 MHz: 7 dB; 890 MHz: 7.5 dB.
- Output—+40 dBmV for 3 channels at –46 dB cross modulation.

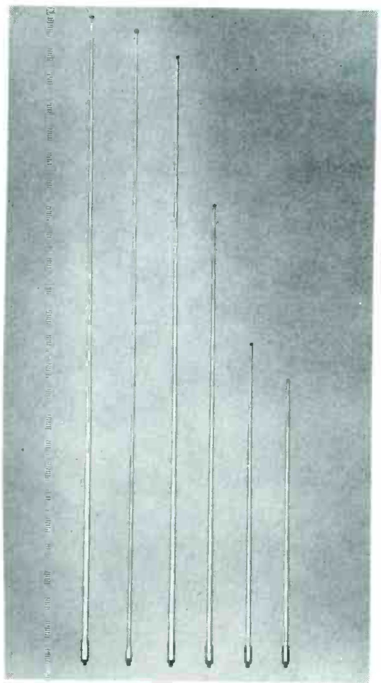
Price is $150.00.

*Circle 61 on literature card*

### CB Antennas

A new line of mobile Citizens-band antennas ranging from 18- to 105-inches, and available in fiberglass or stainless steel, has been introduced by Pearce-Simpson, Inc.

Featured in the new line are the 1 To 1 PLUS 4 and the 1 TO 1



PLUS 6. Both are constructed of white fiberglass and are equipped with an adjustable tuning tip to give the lowest possible SWR, according to the manufacturer. The top-loaded design of the 1 To 1 PLUS Series reportedly solves the problem of low efficiency.

The 1 To 1 PLUS 4 and 1 To 1 PLUS 6 cost $10.95 and $11.95, respectively. ▲

*Circle 62 on literature card*


take it off neat and quick

NEW WIRE STRIPPER-CUTTERS

**3 MODELS TO CHOOSE FROM.** Made in USA to highest quality standards, these tools cleanly strip and cut all commonly used solid and stranded insulated wire.

Features include adjustable screw stop or unique, patented cam for adaptation to different wire sizes. Self-opening handles have slip ring or thumb-operated catch to keep them closed in tool box. Blades are hardened and ground, cut with a smooth shearing action. Handles have comfortable Cushion Grips.

WRITE FOR DESCRIPTIVE LITERATURE.

*nationwide availability through local distributors*

XCELITE®

XCELITE, INC., 18 Bank St., Orchard Park, N. Y. 14127
In Canada contact Charles W. Pointon, Ltd.

*Circle 28 on literature card*

The look, feel, and sound of tomorrow's CB radio...

**Here today in the all new Messenger 121!**

From the engineering that brought you the famous Messenger 100 . . . a new generation of citizens radio equipment with even greater performance! New punch-button controls for instant channel selection. Voice tailored audio and acoustically isolated speaker for really clear sound. Plus exclusive Johnson speech compression circuitry, new ceramic filter, and more!

*You're going to hear more from...*

JOHNSON®

Waseca, Minnesota 56093

1211

*Circle 29 on literature card*

# product report

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

### Glass and Plastic Cleaner

Mask-N-Glas, a product of Chemtronics, Inc., is an aerosol spray formulated for cleaning picture tubes, television masks, glass and portable cabinets.

Once it is sprayed on, a quick wipe leaves the surface clean, whether glass or plastic, according to the manufacturer.


Mask-N-Glas reportedly is non-abrasive, non-staining and leaves an anti-static coating that will not attract dust or dirt. Each spray-can includes a lint-free polishing cloth.

Mask-N-Glas is available in 8-ounce cans and sells for $1.79.

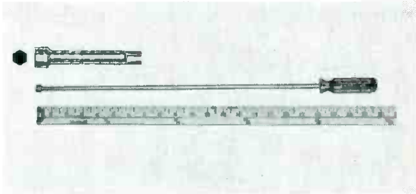
*Circle 70 on literature card*

### Long-Reach Nut Drivers

Two long-reach nut drivers have been introduced by the Vaco Products Company.

The drivers are available in two sizes: ¼ inch and 5/16 inch hex. They reportedly extend 18 inches out of the handle for turning deep-set hex nuts and screws during the servicing of TV and other electronic products.

These nut drivers feature hollow shafts, tempered sockets and large Comfordome handles, according to the manufacturer.



No. S-818 (¼-inch size) and No. S-1018 (5/16-inch size) sell for $4.80 each.

*Circle 71 on literature card*

### VHF/FM Radiotelephone

Pearce-Simpson has introduced a VHF/FM radiotelephone communications system, the CAPRI VHF.

The CAPRI VHF reportedly offers 25 watts of maximum allowable power and 12 channels.

Constructed of non-corrosive Cycolac®, some of the CAPRI VHF's features reportedly include: a solid-state receiver; a crystal filter, for adjacent channel rejection; a "1-watt" switch position, for short-

range communication; plug-in transistors; fiberglass circuit boards; plus, integrated circuits and a field-effect transistor.

The CAPRI VHF sells for $299.95.

*Circle 72 on literature card*

### Three-Temperature Heat Gun

A flameless heat gun designed to be used with one of three different color-coded nozzles, each supplying a different heat range, has been introduced by Ideal Industries.

The gold nozzle is suitable for most heat shrinkable materials; a green nozzle for Mylar® and a red nozzle for Teflon® are optional. The three nozzles are of plug-in design, and provide temperatures up to 1200-degrees F.

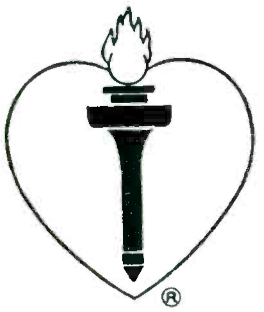
Your Heart Fund Fights

HEART ATTACK

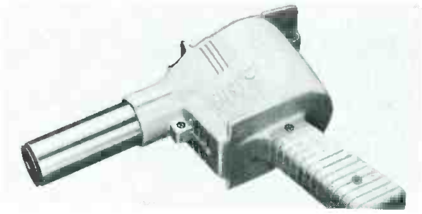
STROKE

HIGH BLOOD PRESSURE

INBORN HEART DEFECTS



Power requirements reportedly are 120 volts AC, 60 Hz and 4.5 amps maximum. Control is by a three-position thumb switch that provides OFF, COOL, or HOT operation.



The heat gun weighs 1¾ pounds and sells for $59.95.

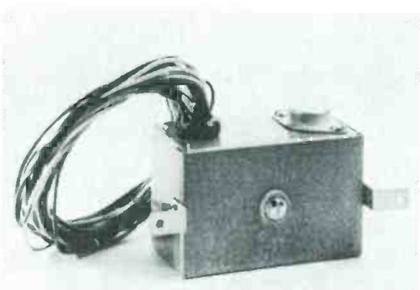
*Circle 73 on literature card*

**Stereo/Radio Speaker Switcher**

"Switch-O-Matic", a solid-state automatic-switching device that permits a car radio to play through a tape system's stereo speakers, has been introduced by GC Electronics.

Audiotex "Switch-O-Matic" 30-3160 reportedly applies audio power to the loudspeakers, eliminating the need for internal switching in the tape player system. When the tape player is being used, "Switch-O-Matic" disconnects itself, according to the manufacturer.

Model 30-3160 is installed by making connections between the output and power leads of the radio and stereo player and the stereo speakers in the car.



Switch-O-Matic measures 3¼ inches x 2⅛ inches x 1⅝ inches, is housed in a metal box and can be mounted out of sight behind the dashboard.

Model 30-3160 sells for $17.95.

*Circle 74 on literature card*

▲

**For more information about above products use reader service card**


# The RCA portable color bar generator


## Performs like the big ones Costs only $75*

- Provides color bar, dot, cross hatch, and blank raster patterns
- All solid state circuitry including ICs
- Pattern signals, RF output frequency and color subcarrier all crystal-controlled
- Battery operated, AC adapter available
- Lightweight — less than 20 oz., only 6½" wide x 4" deep x 3" high

For all the technical specs get in touch with your RCA Distributor. RCA | Electronic Components | Harrison, N.J. 07029.

* Optional User Price

RCA

*Circle 35 on literature card*

by Joseph J. Carr/ES Auto Electronics Editor

# Eight Prime Problem Areas in Auto Electronics

This month we are going to discuss eight of the most frequently encountered problems in automotive electronics. Many, perhaps most, of the items on our agenda are well known to full-time car radio technicians. The "sometimes" car radio man, however, should find the following information equally useful. Along with some of the more common troubles and cures, I also have listed specialized part numbers and suitable substitutes.

### Car Radio Training

Some of the best car radio training available is given by the Delco Electronics and United Motors Service divisions of General Motors. Schools are given once a year in many locations throughout the country. The author recently attended one such training session at the GM Training Center in Fairfax, Virginia (near Washington, D.C.). What impressesd me about the students was that most of them had traveled relatively long distances to attend.

Mr. Dick Zordel, the Delco Radio Eastern Field Service Engineer, not only presented several good theoretical discussions about various circuits and circuit operations but he also monitored two hands-on lab sessions featuring bugged sets. Dick is a master at creating taxing yet believable problems; quite a contrast to pins stuck through components which seldom fail and other such nonsense found in some technical schools.

These field-service engineers are great sources of information about car radio problems. After all, they only get to work on the sets that other good technicians have failed to fix . . . they leave the gravy jobs to us.

### Craig Eject Solenoids

I would rather not think of the number of times a customer has presented a Craig 3121, 3122, 3123, or 3124 with the complaint: "It blows a fuse every time I insert a cartridge". This series of eight-track tape players uses a solenoid electromagnet to hold the cartridge pinch-lock tang. Fig. 1 is a schematic of the electromagnet circuitry.

#### Original unit

The original circuit used in the early "02" units is shown in Fig. 1A. The pinch arm locks into the slot on the side of the eight-track cartridge, holding it in position.

When the operator wants to remove the cartridge, he presses SW1. This de-energizes the electromagnet. With the electromagnet no longer holding it, the pinch arm tang falls back to its rest position. The cartridge, no longer locked in place, is pushed out of the machine by spring pressure.

There are two separate windings on the older solenoids. One is a high-resistance "hold" winding. The other is a high-current, low-resistance "pull-in" winding. It is used to boost the magnetic field until the tang is firmly seated. The instant the tang is seated, it is supposed to turn off microswitch SW2. This lowers the current through the magnet to a safe operating level. If SW2 is turned off the least bit late, the main power fuse in the 12-volt line will blow.

#### Modification of original

A modification of the older circuit is shown in Fig. 1B. All that is required is to connect the red lead from the pull-in winding to the black lead from the hold winding. On many of these players there is even an unused two-hole pad on the power supply printed-circuit board.

Before making this modification, be sure to check the continuity of the old part. If the problem has persisted for several cycles of the eject mechanism—which usually means that someone used an oversize fuse when the original blew—it probably will have destroyed the electromagnet solenoid. Frequently, there will be no visable sign of burning.

The pull-in winding should have approximately 6 ohms of resistance, while the hold winding should have approximately 97 ohms. Also, an open circuit should be indicated between the two windings.

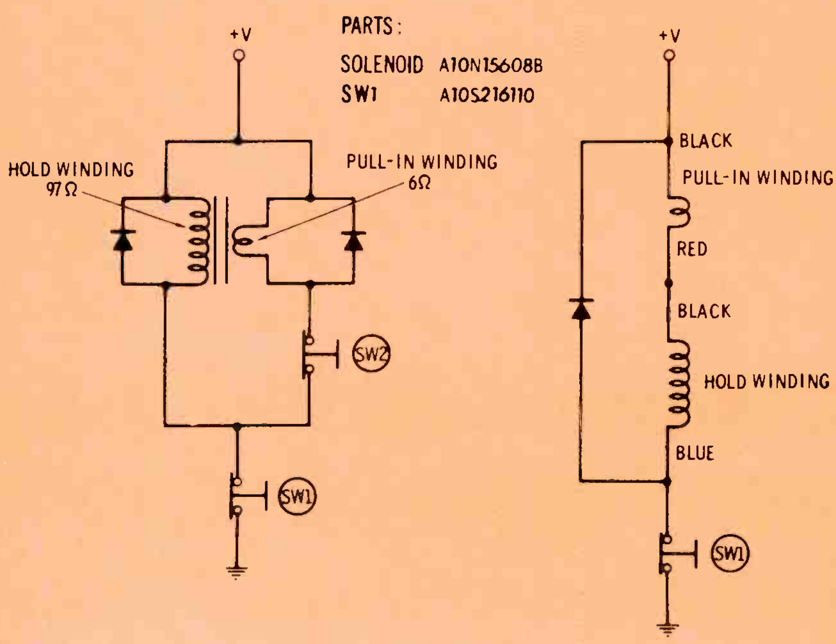
If the solenoid is bad, order a new one either directly from Craig or from their nearest distributor, under part number A10-N-1560B. Before ordering, though, check the eject microswitch. If it has been damaged by the heavy current, as is frequently the case, order a new one under part number A10-S-16110. (This switch, incidentally, is nearly identical to other **"Omran"** switches used in most Japanese tape players.)

#### New units

New solenoid electromagnets have only two leads: one blue, one black. The two windings are already connected, so the modification described previously is not necessary.

When you remove the old solenoid, do not bend or warp any part

**Fig. 1** A) Original design of the circuitry used to activate and hold the cartridge-hold tang in early Craig series of eight-track tape players. Slow turn off of SW2 causes repeated burnout of the main power fuse in the 12-volt line. B) Connecting the pull-in and hold windings in series, as shown, cures the repeated failure of the line fuse.



of the tang or cartridge guide assemblies. The magnetic surface of the tang, the electromagnet and the cartridge guide assembly must be perfectly aligned, or the cartridge will not lock in place.

The electromagnet has an adjustable mounting plate. The assembly is held together by four machine screws in slotted holes. Loosen these screws two at a time to adjust the magnet. In most cases, the marks left over from the original positioning can be used as guides for the initial positioning of the new unit.

### Bendix Output Transistors

In 1968 through early production 1971 units, Bendix used an NPN audio-output transistor that gives a lot of trouble. It is one of those tab-mounted epoxy units. You will find it on Ford, Chrysler, VW and other car radios of Bendix manufacture.

In some 1968 radios, Bendix used a forerunner of the current type of transistor, usually referred to as the "blue dot" or "blue dome." It consisted of the transistor packaged in a small, blue epoxy pellet mounted to a metal baseplate similar to the baseplate of the more familiary TO-3 diamond casing. We continue to find a relatively large number of both of these two transistor types defective.

The symptoms will be no audio and a drastically reduced current drain. On AM or FM mono receivers, the power 0-10 ampere meter will barely flicker when the set is turned on.

Fig. 2 shows a circuit representative of those which use this type of transistor. It is from Bendix Models OFBF and OFBA. The collector voltage on Q3 will be normal or just a little higher than normal.

The specific defect that occurs in Q3 is an open base-emitter junction. This causes the base voltage on Q3, which is also the collector voltage of Q2, to increase to between 7 and 12 volts. The emitter voltage will be close to zero. The cure is a new transistor.

The Bendix part number for these transistors is either 4080866-6 or -9. The only difference between these transistors is that Bendix has properly pre-shaped the leads of the -9 units.

Several transistors from the universal replacement lines, including those offered by RCA, Sylvania, GE, Motorola (HEP), can be used as substitutes for this transistor. Be sure to actually examine the listed replacements before laying out any money. Although they are all electrically usable, some have mechanical differences which will make mounting on a particular radio very difficult.

Mounting such transistors is sometimes a problem. When you encounter the "blue dot" transistor, be sure to salvage the insulators, the small printed-circuit lead terminals and the metal baseplate.

The blue pellet-type case can be removed from the baseplate by unsoldering it's tiny leads from the printed-circuit foil and pulling it from the baseplate with a pair of long-nose pliers. It will be necessary to sand or grind the baseplate surface as flat as possible.

The replacement will be one of those '866- units mentioned previously. The mounting hole in these newer types is too small for the standard screw insulator. Simply enlarge the mounting hole with either a small reamer or one jaw from a pair of long-nose pliers.

There are other mounting methods, but these involve other styles of transistors. In any event, the other

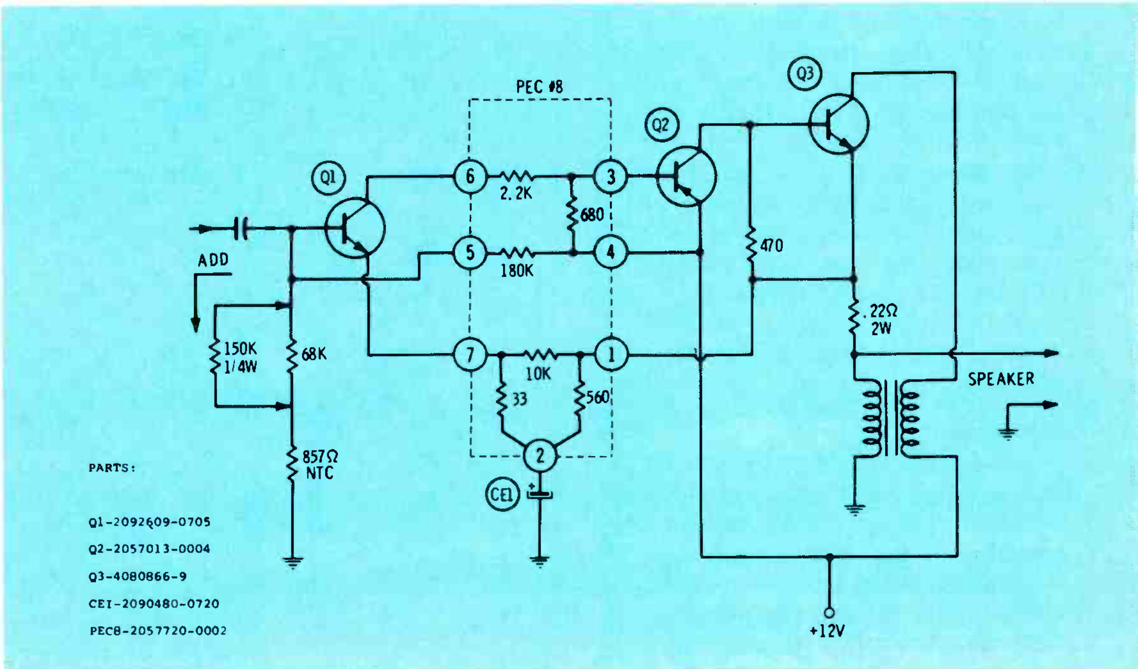



**Fig. 2** Q3, a tab-mounted epoxy type transistor used in AM and FM mono receivers, is prone to failure. The specific defect typically is an open base-emitter junction. Circuitry shown here is used in Bendix radio models OFBF and OFBA.

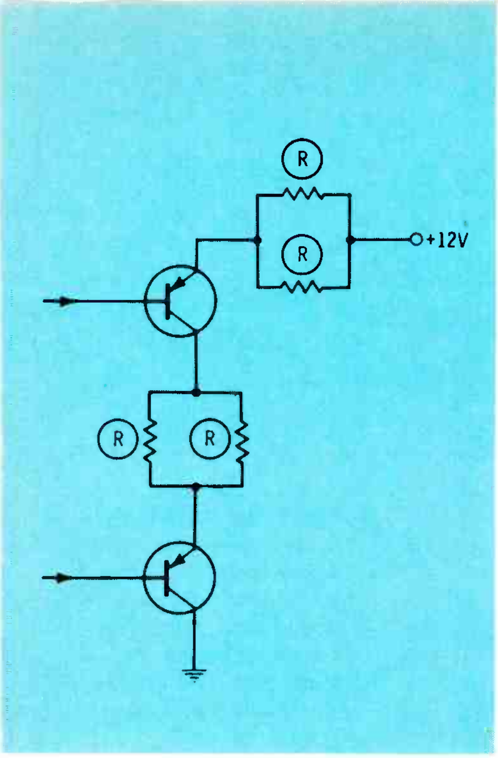



**Fig. 3** Smoke and a terrible smell from an imported tape player are two signs that a fuse resistor, like those shown here, has burned. A common cause is overloading of output stage with too many speakers. Circuit shown here is used in Gibbs Models CR332B and CR630.

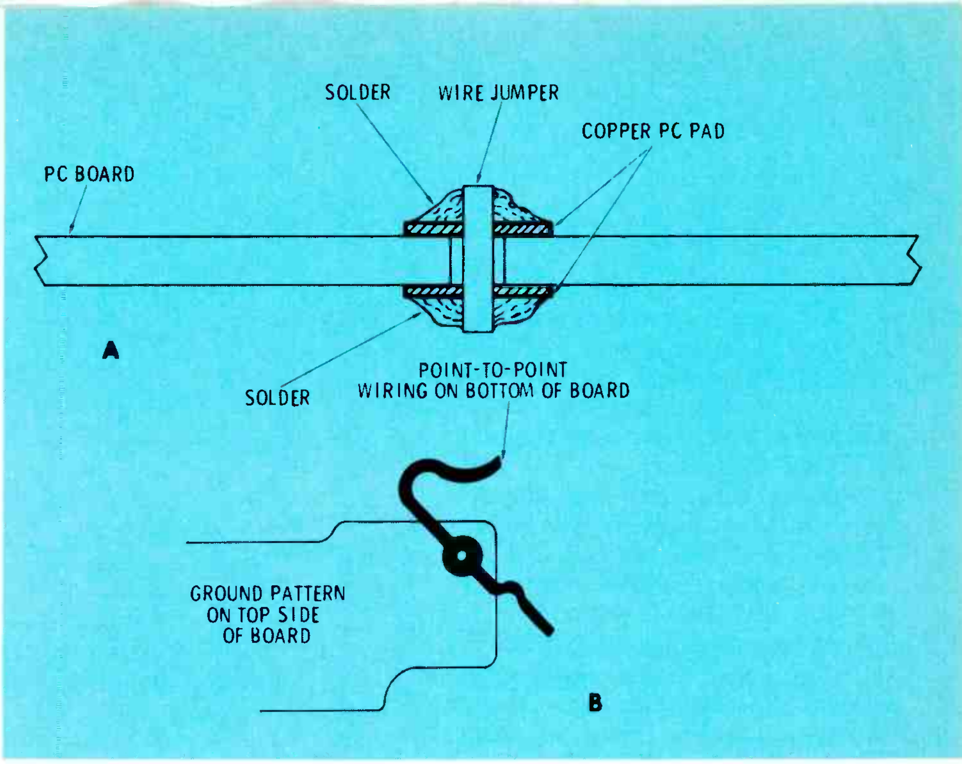



**Fig. 4** Poor connections between the upper and lower patterns of the double-sided printed-circuit boards employed in Blaupunkt auto radios commonly cause intermittent operation. See text for details about proper connections.

methods are not applicable to the '68 VW and '69-'70 Ford Galaxy radios.

The reliability problem associated with the audio-output stages of these radios seems to be related to insufficient heat dissipation. This means that proper use of silicon grease and good mechanical mounting are two absolute musts. The author has lost count of the number that have returned within our labor and parts warranty period because of this problem. We now, however, have two different approaches that help reduce the number of unwanted callbacks: We either reduce the amount of heat that the transistor is required to handle, or we use another type of transistor that has a higher dissipation rating.

Bendix has issued a modification that reduces excessive heating of these transistors in Ford radios. Refer back to Fig. 2. A 68k-ohm resistor is connected in the base bias network of transistor Q1. Because of the direct-coupled nature of the circuit in Fig. 2, we can reduce the current flow through Q3 by modifying the bias on Q1. Bendix recommends placing a 150k-ohm resistor in parallel with the 68k-ohm unit. Because of space limitations in some of the Ford radios, it might be necessary to use a ¼-watt resistor.

Although this modification is specifically for Bendix Ford radios, it should, in principle, work in similar circuits of other models.

The other solution is to use another type of transistor. Most of the Bendix radios already have the necessary mounting holes drilled for either the large diamond (TO-3) or small diamond (TO-66) type of transistors. Later-model Philco car radios, which also use the epoxy transistor, are pre-drilled to accept the TO-66 mounting. In those models, where no such holes exist, it is relatively simple to drill them.

In radios drilled to accept the smaller TO-66 diamond transistor, you can use the same transistor Bendix uses in their truck radios and 1971 Chrysler radios. It is available under part number 4080-838-0001 from local Bendix distributors.

Sets pre-drilled for the TO-3 type transistor have presented a problem. You will find few low-power, silicon, NPN transistors in the TO-3 configuration. In a real case of overkill, the author has been using high-power transistors such as the Sylvania ECG130 or a 2N3055. This is a relatively expensive route to follow, but it does lower the call-back rate.

Before leaving Fig. 2, let's examine another problem that is often mistaken for a bad output transistor. Again, the symptom is no output, but with a difference. There might be some output at high settings of the volume control. Measure the base voltage of Q3. If it is normal (2-3 volts), try bridging CE1 (1000-mfd, 4 WVDC) with a known good capacitor. I'll bet you a worn out Phillips screw driver that this will be the defective part. The offending capacitor, by the way, is a black plastic unit, not one section of the main filter capacitor.

### Imported Tape Player Output Stages

"It smokes and smells like *@/#%%" is a very common complaint registered against some Japanese tape player imports. The problem is usually burning fuse resistors. These resistors are shown in Fig. 3, which is a partial schematic of the output circuitry of Gibbs models CR332B and CR630. It also is common to many other brands.

The customer often is at fault for this type of failure because he fails to heed the warning against connecting too many speakers or paralleling the tape player with the car radio. In these cases, the fuse resistors, and often the power amplifier transistors, probably will burn. The resistors are usually .5- to 2.5-ohm, ¼-watt types. The transistors are usually 2SB474, 2SB405, etc. If the player uses the small 2SB405 type, use either the manufacturer's original replacement or a good universal. Remember, however, that some of the universal replacement guides are a little optimistic in their selection of a substitute. For output applications you will need a replacement with a collector current rating of at least .9 amps and a power rating of several watts, depending on the particular amplifier. Lesser ratings will cause the set to be returned to you (or another technician) within a remarkably short time.

### Blaupunkt Intermittents

Blaupunkt car radios sometimes develop intermittent problems that are particularly difficult to locate. Despite the outward symptoms, these intermittents often are caused by poor connections between the upper and lower patterns on the double-sided printed-circuit board.

The top and bottom foil patterns are connected by a wire jumper through a hole in the board which is common to both tracks. This is illustrated in Fig. 4. Both sides of this jumper should be soldered. Try resoldering the jumpers that are in the affected circuits of the radio. A frequent source of such problems are the jumpers near the tuner mechanism.

### Tape Player Leaf Switches

Fig. 5 shows a type of power switch used in Automatic and other imported tape players. The lower leaf often will be broken or at the point of breaking. Because this is the power switch operated by the eight-track cartridge, if it is broken there will be no way to turn the player on.

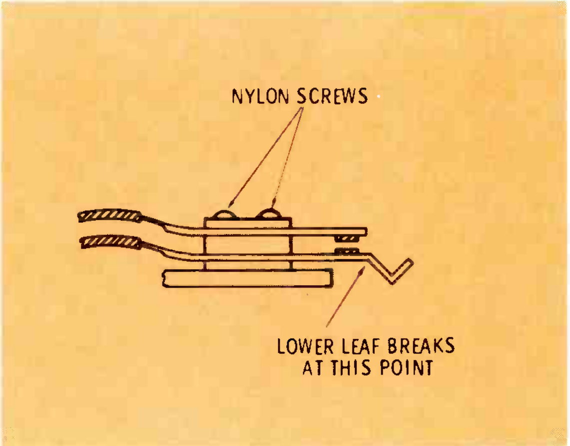



**Fig. 5** The cartridge-activated, leaf-type power on/off switch in Automatic and other imported tape players frequently breaks or is bent. See text for replacement instructions.

Soldering the broken piece onto the remaining section is not a cure. Solder has no strength, and will break easily.

Regardless of whether you buy the entire switch or just the lower leaf, be sure to order replacements for the nylon retaining screws. The odds are about even that one will shear off either when you are removing it or replacing it.

Another problem associated with this type of power switch is excessive bending. In most cases it bends upwards, and the cartridge cannot make contact with it. In such cases, the player will usually be stuck in the on position. In other cases, it will be bent down and backwards in such a way that it will blow the main power line fuse whenever a cartridge is removed. The complaint will be that it plays one cartridge then blows the fuse. This is frequently the cause of an intermittently blowing fuse. Re-bending usually will cure the problem.

### Intermittent Ford Stereo Lamps

In certain late-model Ford stereo radios made by Bendix, there occassionally is a complaint of intermittent stereo or stereo-lamp operation. The monaural function is seemingly unimpaired (before measurement of the FM sensitivity).

First, before you do anything else, examine the FM limiter input transformer, shown in Fig. 6. It has a tuned primary and an untuned secondary. Many of these have been found with little or no solder on one or both posts of the secondary. Although this transformer is relatively small, it is an easy task to remove the shield and resolder the posts. It is even easier to order a new transformer, under part number 205-7713-0705.

### 12FR8 Replacements and Other Parts Problems

No, I cannot tell you where to locate these hard-to-find 12FR8s. This tube, used in Bendix car radios made for Ford back in 1961-62, is no longer made, and most distributor's stocks have long since been depleted.

Judging from the number of requests for information about these tubes published in recent issues of ELECTRONIC SERVICING, I would guess that some shops would like to own a handful. In fact, the last man that I knew who had any wanted twelve bucks a piece for them. Even he is now empty handed. I have heard that a west-coast firm is offering solid-state replacements for the 12FR8. If anybody knows who, where, and how much, please pass the info along.

Also, if for some strange reason you happen to have any, please let us know. We will be happy to pass the info along to other readers. (I just know that someone who was in the car radio parts business back in the early sixties must have a couple cases of 12FR8s, and is not aware that he owns a gold mine.)

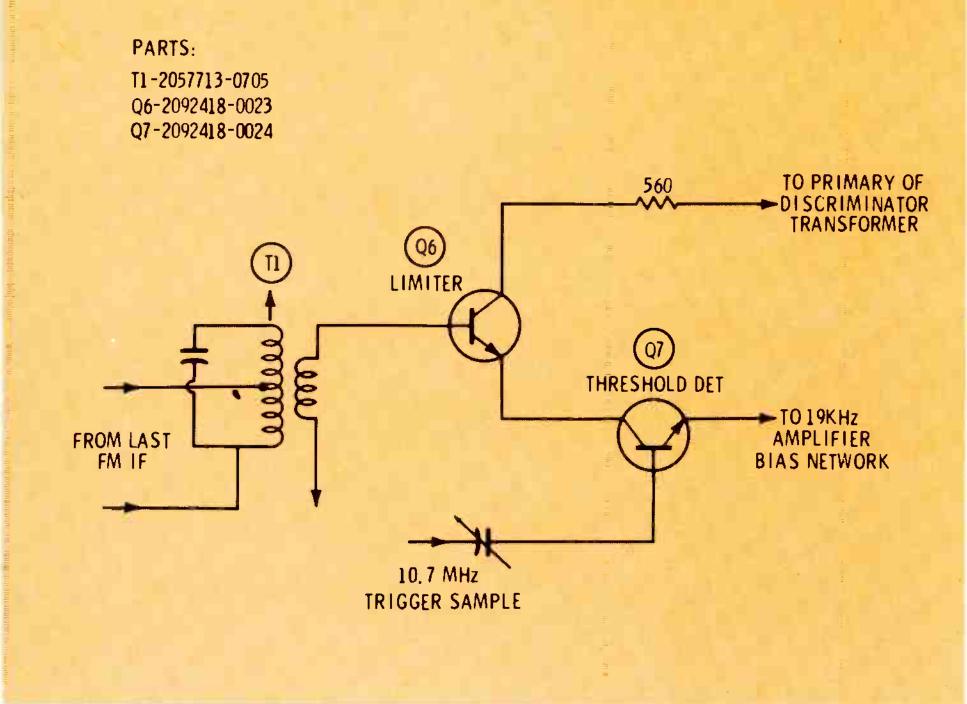



**Fig. 6** Inadequate solder on one or both terminals of the secondary of transformer T1 is a common cause of intermittent stereo or stereo-lamp operation in certain late-model Ford stereo FM radios.

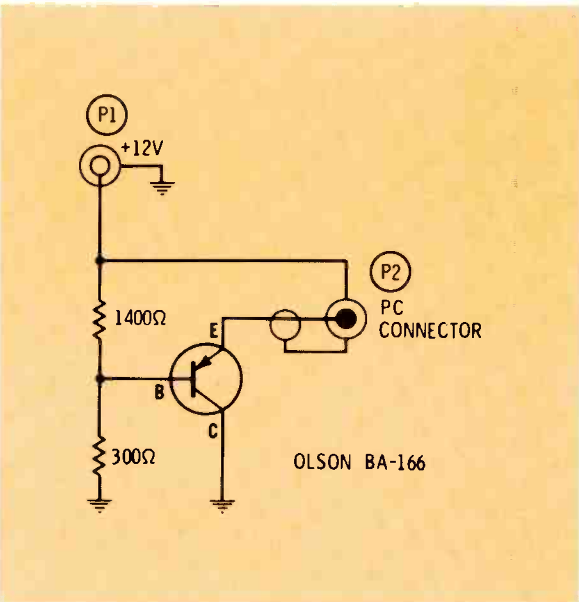



**Fig. 7** Simplified schematic of Olson Model BA-166 converter, which steps down 12 volts to either 9 or 6 volts. Transistor functions as a variable resistor, to drop the unwanted portion of the original 12-volt input.

Whenever you have a unique parts problem with a car radio or an auto tape player, exhaust **all** sources and resources before giving up. There is often a great deal of similarity of parts used in the various brands of imported sets. Sometimes an Automatic or Craig part (both of which are available) will fit another brand.

In **really** difficult cases, send me all of the particulars. I am not in the parts business but I do have a fair amount of info about manufacturers, interchangeability, etc. Perhaps I can find a source for you.

### Outboard Voltage Converters

The customer who owns a pre-1967 VW or any other 6-volt automobile often has a frustrating time locating a radio or tape player that will operate in his car.

Some manufacturers supply an outboard converter that will allow the use of a 12-volt unit in a 6-volt car. Most of these devices use a 2 KHz, or so, transistor chopper oscillator to drive a 6- to 12-volt step-up transformer. The transformer primary from the secondary is rectified, filtered and fed to the 12-volt power line of the radio or tape player.

When ordering one of these units for a customer, check the current rating. If it is too low, it might let the tape cartridge play but not change tracks. This is caused by the higher current requirements of the solenoid which accomplishes track changing.

Another type of converter was recently the subject of a letter from a shop in the midwest. This type of converter steps down the normal 12 volts used in cars to either 6 or 9 volts, to operate a portable radio or casette tape player.

A simplified schematic of one such unit, the Olson model BA-166, is shown in Fig. 7 (6-/9-volt switch eliminated). The transistor in this circuit functions as a variable resistor. It drops the unwanted portion of the circuit voltage. A transistor is used rather than a simple resistor because the current requirements of modern solid-state sets vary more from minimum to maximum volume than did the old tube sets. The electronic variable resistor (transistor) can react fast enough to compensate for these variations.

(Some of our readers might remember the old dropping resistors used for this type of service back in the tube days. These were mammouth affairs with a cylindrical, perforated heat radiator that was bolted to the automobile firewall. They could be used because the current variations were too small to be significant. The filament current for five to eight vacuum tubes and the large losses inherent in the vibrator power supply had a swamping affect on the percentage of change caused by audio amplifier settings.)

Use of a resistor dropping circuit in solid-state equipment might easily damage transistors and the low-voltage electrolytics which are common to solid-state receivers. (Bendix, by the way, supplied VW dealers with similar converters so that in-stock 1966 radios could be used in 1967 cars.) ▲

# High-Voltage Regulation and Safety Circuits

For the first ten or more years that color television was available, the high-voltage regulation system remained a simple shunt regulator. Since then, however, a couple of new schemes have been developed, each with its own advantages and peculiarities.

More recently still, the Department of Health, Education, and Welfare has begun establishing rules concerning the amounts of high voltage which a receiver may produce under fault conditions, thus leading to the design of numerous high-voltage "hold-down" circuits, and "fail-safe" high-voltage systems.

All this has made the simple old circuit using a 6BK4 with controllable bias a little passe. And, while these new circuits **do** prevent the generation of excessive high voltage (with the possible generation of X radiation), the possibilities of malfunction are somewhat increased and the symptoms might be changed from what they used to be.

In this article, some of the present-day regulation and safety systems will be described, along with some troubleshooting ideas.

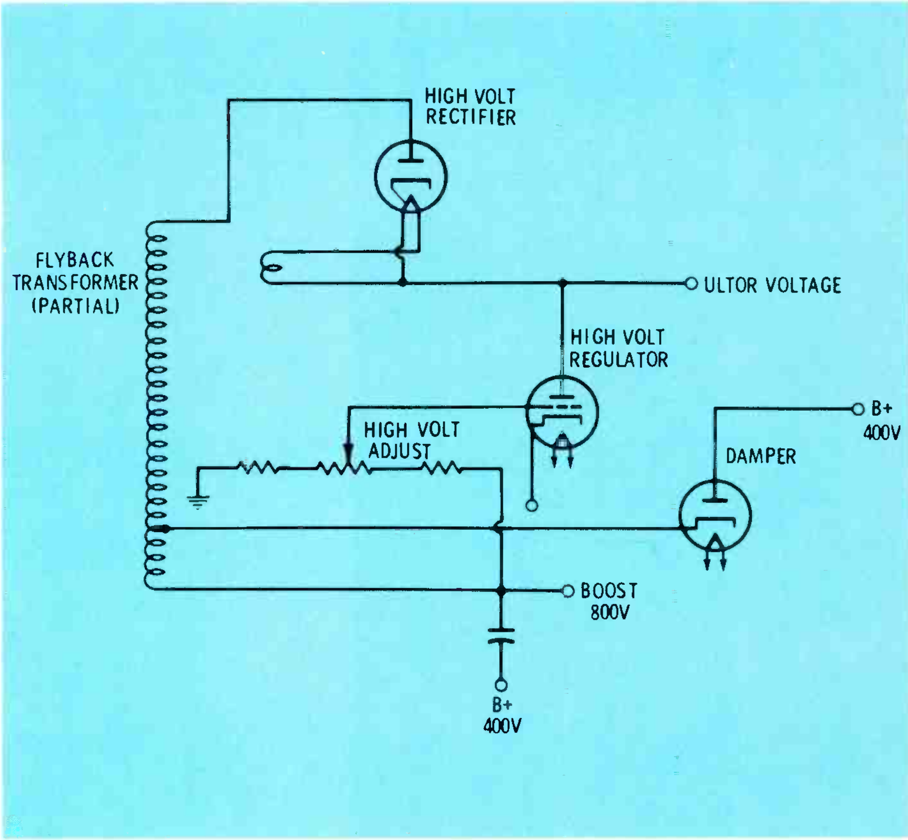



Fig. 1 Conventional shunt regulator.

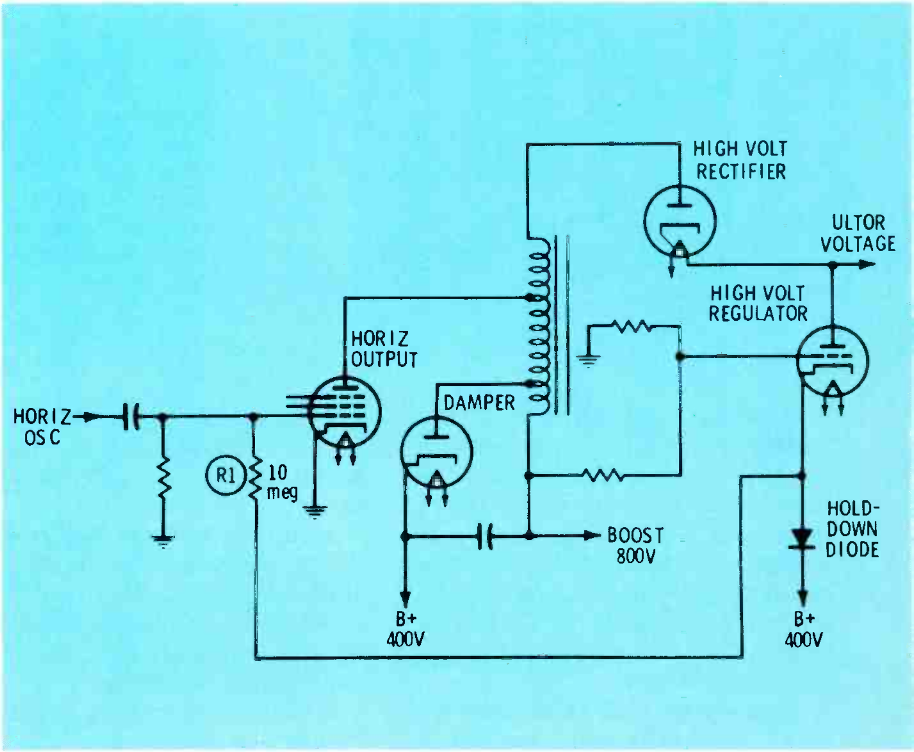



Fig. 2 Shunt regulator with hold-down circuit.

*by Bruce Anderson*

### Shunt Regulators

The familiar shunt regulator is shown in Fig. 1. The basic principle of operation is fairly simple: Because the picture tube requires about 1.2 mA of current at maximum brilliance, the flyback transformer is designed to produce a pulse of sufficient amplitude to produce 25 KV of DC at this level of current. If the picture-tube load decreases, the high voltage tends to rise, and the B-boost voltage also tends to rise. This, of course, increases the conduction of the regulator tube (the 6BK4) so that the current drain on the high-voltage power supply remains constant.

One of the basic faults of the shunt regulator is that high voltage tends to increase as the regulator tube ages, and increases to maximum (typically in the neighborhood of 32 KV) if the tube loses all emission. This is very undesirable for two reasons: Excessive high voltage can cause arcs or damage to other components, and it can cause the emission of X-rays. A secondary problem—misadjustment of the high-voltage control—was solved by substituting precision fixed resistors for the potentiometer in the regulator grid circuit, or by using a factory sealed potentiometer which "self destructs" if adjustment is attempted.

Fig. 2 illustrates a method of preventing an increase of high voltage if regulator emission drops toward zero. The grid resistance of the horizontal-output tube is made so large that the grid voltage thus developed would nearly cut off the tube if the resistor was connected to ground; but, because the resistor returns to B+, the tube operates normally. However, B+ is available to the 10-megohm resistor only if the regulator tube is conducting. If the regulator tube is removed from its socket, for example, the diode in its cathode circuit becomes reverse biased, removing the positive voltage from R1.

Typically, the grid voltage of the horizontal-output tube is –50 to –55 volts. If B+ is removed from R1, the grid voltage of the horizontal-output tube will swing more negative, to about –65 volts. This, of course, reduces the amount of output from the tube and causes the high voltage to decrease to about 20 KV instead of increasing to about 32 KV, as it formerly did.

From the troubleshooting point of view, it is unlikely that the diode will open, so it is impossible that loss of high voltage will be caused by failure of the safety circuit. It is important to remember that failure of the regulator tube will cause a reduction of high voltage, regardless of whether it loses emission or conducts excessively.

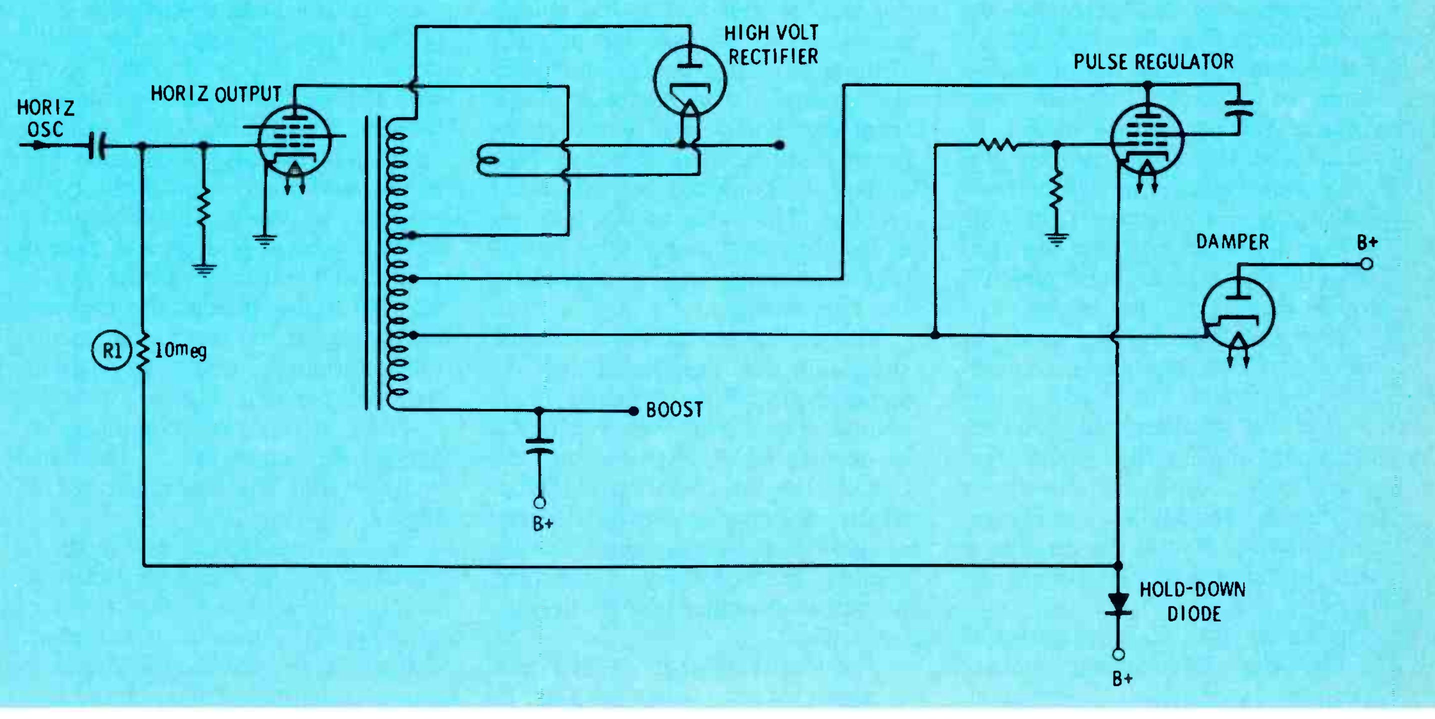



**Fig. 3** Pulse regulator with hold-down circuit.

If a regulator tube shorts, it might short the diode. This will not cause abnormal operation (once the regulator tube is replaced) but the safety feature will have been lost.

Whenever the regulator is replaced, it is advisable to check the operation of the safety circuit by checking the high voltage with the plate cap removed from the regulator, or with the tube removed. If the high voltage decreases, all is well; if it increases, the diode probably is shorted.

### Pulse Regulators

One of the inherent disadvantages of the shunt regulator is that it wastes power. Because it operates by loading the high-voltage system when the CRT current is slight, the effect is to force the system to deliver full power at all times.

Obviously, a regulator which consumes less power is desirable, because all the high-voltage power must come from the horizontal-output tube. One such regulator is the **pulse** type.

Fig. 3 illustrates the interesting features of the pulse regulator. (A large portion of the horizontal-output circuitry has been deleted for simplicity.) In effect, the pulse regulator is a "spoiler" for the transformer. During retrace time, the plate, screen grid and control grid are driven positive by pulses from the flyback transformer. If high voltage tends to increase, the control grid pulse grows more positive, which loads (to some degree) the flyback winding and decreases its efficiency. This decreases the amplitude of the pulse at the plate of the high-voltage rectifier and stabilizes the ultor voltage. It is possible to provide high-voltage adjustment by varying the fixed bias of the regulator tube; but this is no longer done, as required by HEW regulations.

A safety feature is incorporated in the design, and it operates about the same as the one used with shunt regulators. If the pulse regulator tube does not conduct, B+ is removed from R1, and the grid of the horizontal-output tube swings more negative, reducing the high voltage. As in the shunt-regulator safety circuit, troubleshooting is not changed much, except that the high voltage decreases when the conduction of the regulator tube decreases below about 1 mA.

### Grid Regulation

Another method of high-voltage regulation is to "AGC the horizontal output". As demonstrated by the safety circuits that are used with both the shunt and pulse regulators, the high voltage can be reduced simply by increasing the negative bias on the control grid of the horizontal-output tube. In the safety circuits, the bias change is radical; but it is possible to control the bias gradually as a means of regulation.

The circuit in Fig. 4 shows the essentials of the grid regulator. The grid voltage is determined by the grid-leak bias of the tube itself and the DC voltage obtained by rectifying a sample pulse from the flyback transformer. (Some circuits also connect the grid to B+ via a high resistance, to increase the output.) If the high voltage tends to increase, for example, the feedback pulse from the flyback also tends to increase, and a more negative bias voltage is produced by the diode rectifier. This adds to the self-bias of the horizontal output tube, reducing its condition and, consequently, the high voltage.

This circuit has the advantage of simplicity, and, superficially, it consumes none of the precious high-voltage power. However, regulation is accomplished by changing the bias of the horizontal-output tube, which can operate most efficiently at only one bias point. Consequently, the efficiency of the tube is somewhat reduced by the regulator action.

The bias-rectifier diode in Fig. 4 is connected as a series rectifier. In practice, it may be connected this way or as a shunt configuration. The positive excursions of the input pulse are shunted by the diode, and the negative swings charge the filter capacitor, C1, to some average negative DC level.

RCA employs in its CTC 53 and 55 chassis an interesting variation of the grid-regulated system. This circuitry is shown in Fig. 6. A voltage-dependent resistor (varistor) takes the place of the diode rectifier used in the circuitry in Figs. 4 and 5. When less current is drawn from the high-voltage system because of a reduction in brightness (or for some other reason), the feedback pulse from the flyback increases. This changes the resistance of the varistor and, hence, the self-bias of the horizontal-output tube, which becomes more negative. Conversely, increased loading of the high-voltage power supply reduces the amplitude of the feedback pulses, and ultimately reduces the grid bias. Typically, the grid bias varies from around –56 volts at minimum brightness to –42 volts when brightness is at maximum.

### Other Safety Circuits

One type of safety, or "hold-down", circuit was discussed along with the shunt and pulse regulators, because it is so closely tied to their operation. Several others also are in use, and while each of the types may vary in detail, an understanding of their general principles of operation should suffice for troubleshooting. With the increasing emphasis on safety, it is likely that many more variations, and new types as well, will appear in the 1972 models.

Three methods of obtaining voltage for the screen grid of the horizontal-output tube are illustrated in Fig. 7.

In 7A, the typical 140 volts is obtained by dropping the 400-volt supply with a high-wattage resistor. The bypass capacitor is essential; without it, the screen grid degenerates and the high voltage drops several thousand volts. This trouble occurs often enough that many technicians have seen it. The 47-ohm resistor is a parasitic supressor.

Fig. 7B shows the screen-grid voltage being obtained directly from the 140-volt supply. No specific screen bypass capacitor is necessary, because the output filter of the power supply serves this function.

The circuit in Fig. 7C is a combination of the previous two. In normal operation, electron current flows from both the screen grid and the 130-volt supply through R1 to the 300-volt supply. Because the diode is forward biased, the output filter of the 140-volt supply bypasses the screen grid of the tube.

Now assume that for some reason the control-grid bias of the tube is reduced (made less negative) to some abnormal level. (This could be the result of a shorted diode in the circuit of Fig. 5, for example.) With the circuit in either Fig. 7A or 7B, the tube current would increase, which could cause a tube failure or possibly excess high voltage and some other failure.

The circuit of Fig. 7C prevents this from occurring. If the control-grid bias drops too low, the screen current increases to the point where more than 160 volts is dropped across R1. This reduces the screen voltage to less than 140 volts, and cuts off the diode. When the diode is cut off, the output filter capacitor of the 140-volt supply is isolated from the screen grid. This causes degeneration and subsequent reduction of tube current and high voltage to a safe level. Service will be required to repair the initial failure, but the likelihood of a secondary failure seemingly is reduced by this circuit.

A second means of limiting high voltage to a reasonable level in the event of a malfunction is by providing **redundant regulation.** For example, some variation of the grid regulator circuit shown in Fig. 4 may be used with a shunt regulator such as the one in Fig. 2. If so, the components of the grid circuit will

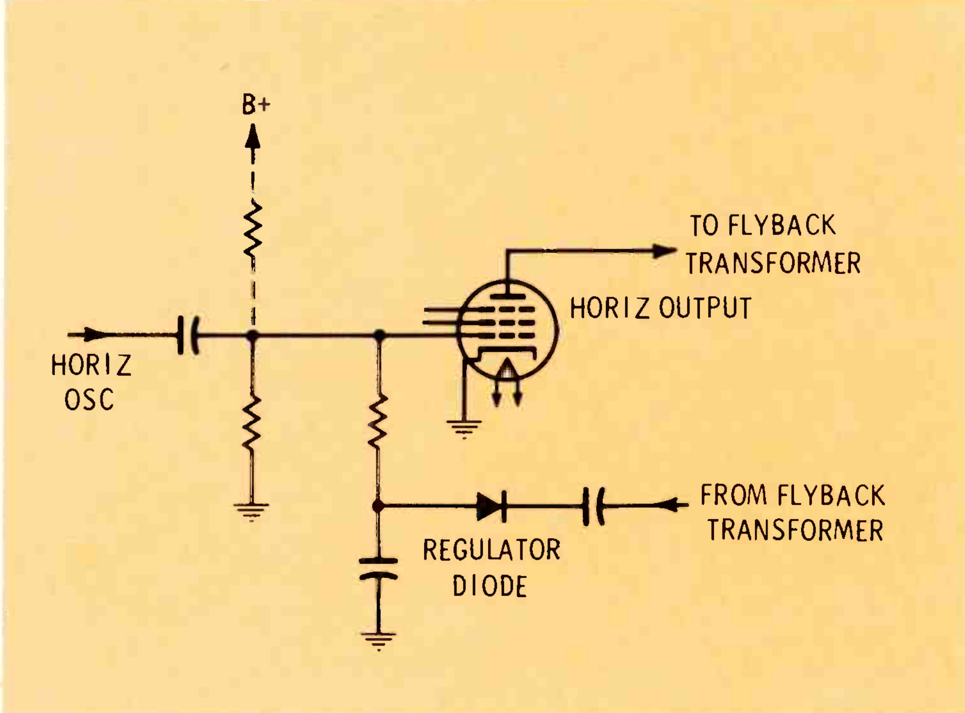



Fig. 4 Simplified grid regulator with series rectifier.

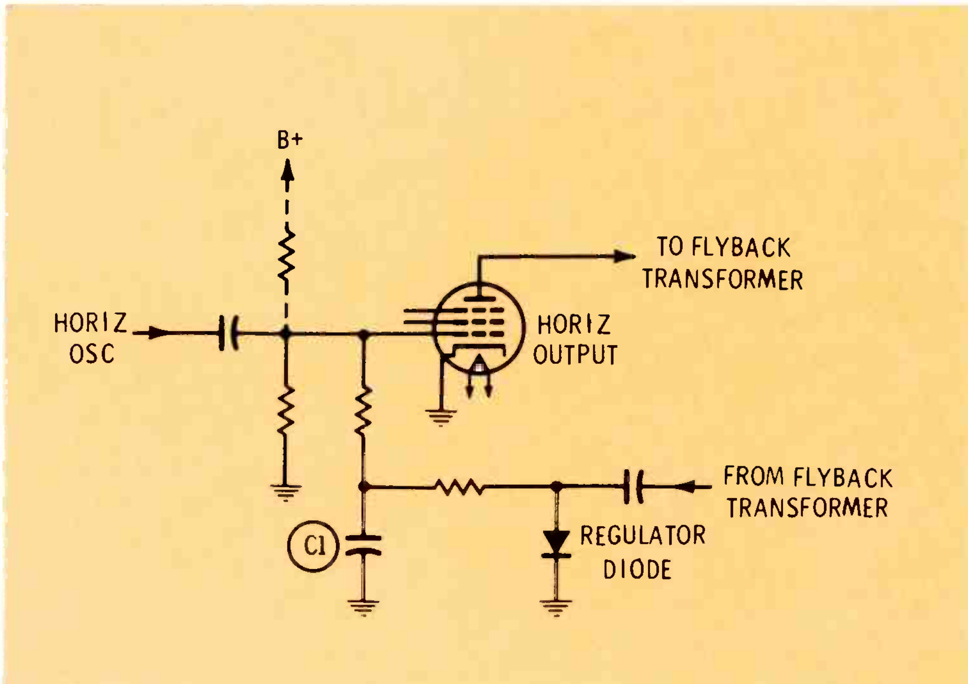



Fig. 5 Simplified grid regulator with shunt rectifier.

be specially designed to hold down the high voltage in the event that the other regulator circuit fails.

Another approach is to include in the design a circuit which monitors the high voltage, and drives the horizontal oscillator off frequency if there is too much high voltage. Again, there are a lot of possible variations of the circuit, but Fig. 8 illustrates the basic idea.

Assume that the oscillator circuit is designed so that one end of the hold control is at ground potential during normal operation. In the circuit shown, the ground return is through Q1, which is held in saturation by the zener-regulated supply voltage. Countering this regulated voltage is a negative voltage obtained by rectification of a sample pulse from the flyback transformer. If Q1 is a switching-type transistor and R2 is correctly adjusted, the transistor will be held just in saturation. Then, any increase in high

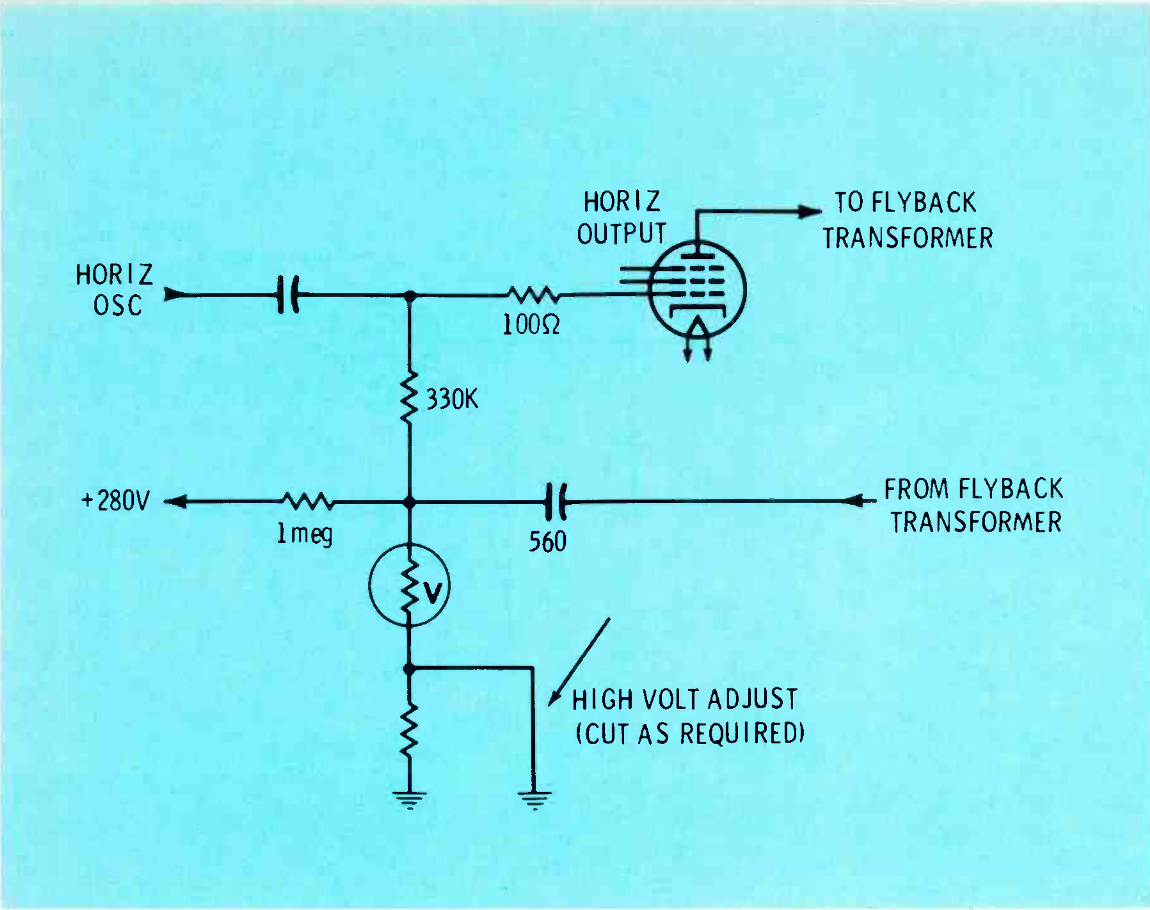



**Fig. 6** Grid regulator with varistor instead of diode.

voltage will increase the amount of negative voltage produced by the rectifier diode which will switch Q1 into cutoff. This has the effect of connecting R1 in series with the hold control, driving the oscillator far enough off frequency to make it impossible to sync the raster.

This does not necessarily hold down the high voltage to a normal level, but it does make the receiver inoperable, and the set will require service to restore operation. Once the high voltage trouble is righted, the hold-down transistor will return to saturation, allowing normal sync to be restored.

### Troubleshooting

When servicing color TV with these types of circuits, remember that the true fault may be obscured by the operation of the safety circuit. For example, the regulator in a receiver using the circuit of Fig. 8 might open, which would increase the high voltage. But this might not be noticed immediately, because the obvious symptom will be loss of horizontal sync. Likewise, partial loss of bias for a conventional horizontal-output tube usually leads to a hot plate and perhaps a modest increase in high voltage; but the circuit in Fig. 4C will maintain a normal-temperature plate, and will reduce the high voltage.

A second point to remember is that a failure in the safety circuit itself might not be apparent, because it might not affect the operation of the receiver. As mentioned earlier, shorting the diode in Figs. 2 and 3 will not cause a malfunction, but it does destroy the safety feature. The same is true of the circuit in Fig. 7C. Consequently, if there has been a failure in the receiver which might have damaged the protector circuit, check the components before you finish the job. A quick check of the diodes might be sufficient, and this is better than no check at all, but follow the manufacturers' recommended procedure whenever possible.

Finally, and this is extremely important, use only replacement parts recommended by the manufacturer when servicing the safety circuits or any circuit which might affect the high voltage. Diodes and transistors might have special turn-on and cut-off characteristics; a certain resistor might be specially chosen because its value always increases under fault conditions, or because it will open without becoming dangerously hot, etc.

### Summary

The "brute force" approach to high-voltage regulation is gradually giving way to more sophisticated, but less power consuming methods. Two of these are **pulse regulation** in the flyback transformer, and **grid regulation** of the horizontal-output tube.

Neither of these regulators is particularly difficult to service, if its basic principles of operation are remembered.

In the pulse regulation scheme, an increase in high voltage increases the conduction of the pulse regulator, reducing the efficiency of the flyback transformer by partially shunting it.

In the grid regulator, a sample of the flyback pulse is rectified and used to set the bias of the control

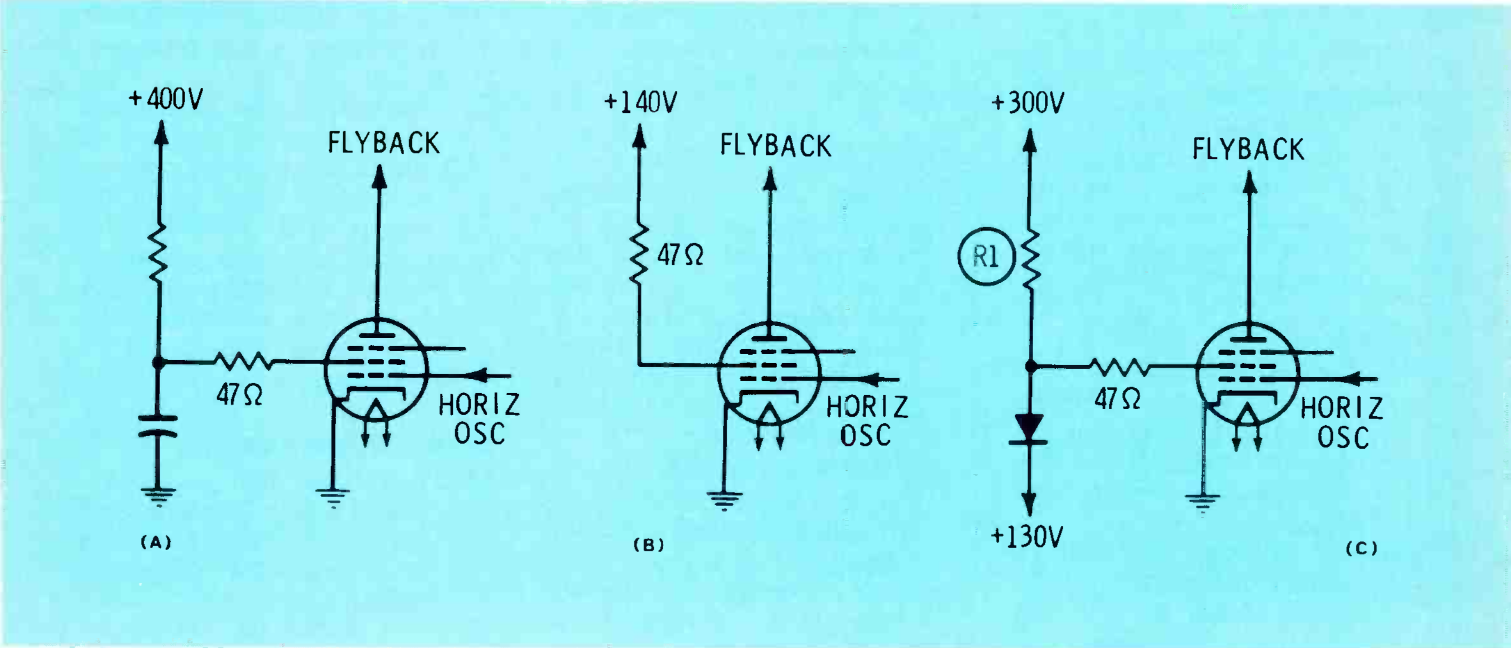



**Fig. 7** Methods of supplying the screen grid of the horizontal output tube: A) Bypassed screen-dropping resistor. B) Low-voltage screen supply. C) Switched-diode bypass of screen-dropping resistor.

grid of the horizontal-output tube.

In the past year or so, manufacturers are incorporating special circuits into their designs to prevent the generation of excessive high voltage under fault conditions. These include fault detectors for shunt regulators and pulse regulators, as illustrated in Figs. 2 and 3. Switching the screen-grid bypass is a direct means of limiting the output of the horizontal-output tube by degeneration. Redundant regulation, in which two independent regulators are used, is a third approach, and fault indicators which drive the horizontal oscillator off frequency are a fourth.

Servicing these new circuits is not really so difficult because they use relatively few parts and the operating frequencies are not high. The important thing is to be aware that one of these circuits is actually there, and that the odd symptoms are a result of the fact that it is doing its job. Then proceed to the troubleshooting checks that have always been valid in high-voltage circuits, and when you find the real fault, the safety circuit will "go back to sleep" until it is needed again. ▲

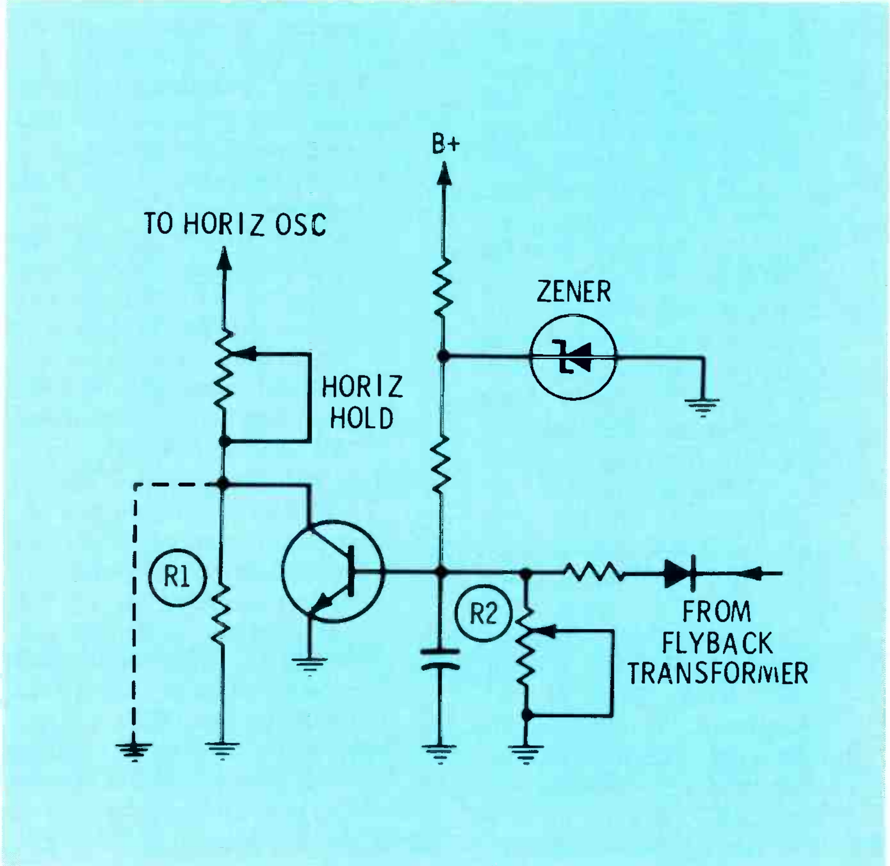



**Fig. 8** Typical oscillator disabling circuit.

# catalogs literature

## ACCESSORY ITEMS

100. *Russell Industries* — announces their Catalog No. 72, which covers bumper feet and grommets. A new line of nylon "Caterpillar" grommets are included.

## ANTENNAS

101. *Antenna Specialists* — has prepared a new complete line catalog describing its monitor products, covering 27 different antennas and accessories.
102. *Jerrold Electronics Corp.*—Catalog S, titled "Systems and Products for TV Distribution," lists specifications of this manufacturer's complete line of antenna distribution products, including antennas and accessories, head-end equipment, distribution equipment and components, and installation aids.
103. *Jerrold Electronics Corp.*—has released a 56-page full line general distributor catalog which includes a guide to MATV systems and nearly 300 Jerrold products. The catalog cost is $1.00.
104. *Russell Industries* — announces the availability of a complete line of telescoping antenna rods with swivel bases and sliding adapters for rods to disappear. This line is ideal for walkie/talkie and all portable radio applications.
105. *Vikoa, Inc.* — is making available a 64-page, illustrated catalog covering their line of wire and cables and IDS/MATV equipment. Hardware, accessories, connectors, fittings and an index also are included.
106. *Winegard Antenna Systems* —has made available a 32-page catalog, designated No. 710, which gives specifications and descriptions on commercial systems equipment. Winegard offers a complete selection of fine quality solid-state amplifiers, boosters and electronic devices for MATV systems.

## AUDIO

107. Altec *Lansing*—introduces a 12-page brochure for information on sound systems in the sports and entertainment field, stadiums, automobile speedways, hotels, restaurants and other public entertainment facilities.
108. *Bell P/A Products Corp.*—new 6-page catalog gives detailed specifications and descriptions of the company's broad line of commercial sound components and special purpose sound system products.
109. *Darome, Inc.*—has released an 8-page brochure showing how a complete background music, local public address, and constant level paging system can be installed without using relays or complicated wiring.
110. *Duotone Company* — has made available a new color replacement needle wall reference chart. The chart covers almost all of the major manufacturers from American Microphone and Audax to Telefunken and Zenith. All catagories are grouped according to manufacturer enabling quick and precise answers.
111. *E-V/Game, Inc., Div. of Electro-Voice* — has announced the new 32-page 1971 Catalog 71D, showing their complete line of record changer and tape record belts, drives and other related replacement parts. Features include: "Fraction to Decimal Equivalence Chart", and a 13-page Cross Reference Section.
112. *Jensen Manufacturing Div.* —has issued an 8-page catalog, No. 1090-E, which describes applications of 167 individual speaker models. Special automotive, communications, intercom and weathermaster speakers, plus a complete line of electronic musical instrument loudspeakers are featured.
113. *Nortronics Co., Inc.* — has released a new Tape Head Replacement Guide which contains tape head replacements for over 2,800 domestic and foreign recorder models, a cross-reference to both model and head part numbers for reel-to-reel and cartridge recorders.

## AUTO ELECTRONICS

114. *Littelfuse, Inc.* — has released a new 32-page, 1971 automotive replacement fuse guide for passenger autos, sports cars, trucks, and taxi cabs. Fuse descriptions and circuits they protect are included.*

## COMPONENTS

115. *Arco/LDP Div. of Loral Corp.* — has published a new cross-reference guide and price book for its miniature aluminum electrolytic capacitors. The four-page publication includes specifications for the Arco/LDP line of Miniature Arcolytics, cross-references them by part number with similar products of other capacitor manufacturers.
116. *General Electric Tube Department* — has released a new 52-page Entertainment Semiconductor Almanac, No. ETRM-4311F. The almanac contains approximately 20,000 cross references from JEDEC, or OEM part numbers to GE parts numbers for universal replacement semiconductors, selenium rectifiers for color TV, dual diodes, and quartz crystals.*
117. *General Electric* — a 12-page, 4-color, illustrated "Picture Tube Guidebook", Brochure No. ETRO-5372, provides a reference source for information about GE

color picture tube replacements and tube interchangeability.*

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

119. *Motorola, Inc.* — has made available a HEP cross reference guide catalog No. HMA07 which lists replacements for over 27,000 different semi-conductor device type numbers available through authorized HEP suppliers.

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

121. *RCA Distributor Products*—is offering an 8-page illustrated pamphlet entitled "When, Where and Why It Pays To Switch To RCA Alkaline Rechargeable Batteries," No. 1P1385.*

122. *RCA Solid-State Division* has made available a new 28-page catalog describing the selection of RCA thyristors (triacs and SCR's), rectifiers, and diacs. Data for each type of device is arranged by series and in order of ascending current.*

123. *RCA/Solid State Division* — announces a revised edition of the Power Transistor Directory, which reflects new product programs, as well as new product data. All product matrices have been updated to include the latest commercial types as well as preliminary data on developmental types, including RCA power transistors, both silicon and germanium. The Index of Types has been expanded to include DT types as well as JEDEC (2N-Series) types and RCA 40-K series types. Copies are $.40.*

124. *Semitronics Corp.* — has a new, revised "Transistor Rectifier, and Diode Interchangeability Guide" containing a list of over 100 basic types of semiconductors that can be used as substitutes for over 12,000 types. Include 25 cents to cover handling and postage.

125. *Sprague Products Co.*—has announced a 40-page manual which lists original part numbers for each manufacturer, followed by ratings, recommended Sprague capacitor replacements, and list prices. More than 2,500 electrolytice capacitors are included.*

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

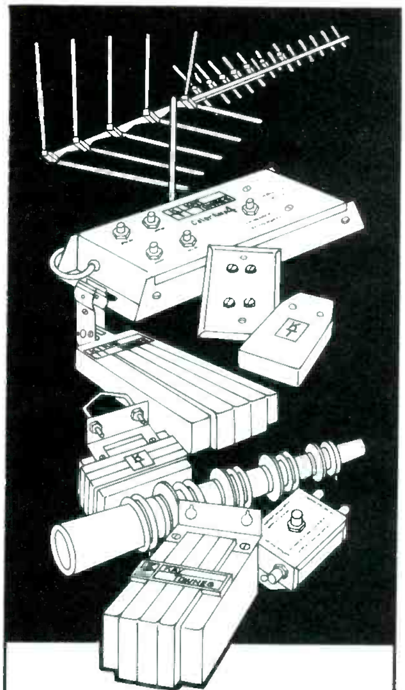
127. *Sylvania Electric Products, Inc.* — a 73-page guide which provides replacement considerations, specifications and drawings of Sylvania semiconductor devices plus a listing of over 35,000 JEDEC types and manufacturers' part numbers. Copies are $1.00.*

128. *Workman Electronic Products, Inc.*—has released a 32-page, pocket-size cross reference listing for color TV controls. 105 Workman part numbers are listed in numerical order with specifications and illustrations of the part.*

**TECHNICAL PUBLICATIONS**

129. *Chemtronics, Inc.* — has published a pocket-sized booklet describing typical thermal intermittents and how Super Frost Aid aerosol coolant will locate them. A step-by-step service procedure is outlined.

130. *Howard W. Sams & Co., Inc.* — literature describes popular and informative publications on radio and television servicing, com-

**From Antennas to Wall Outlets KAY-TOWNES Makes Everything!**

One supplier, one distributor can give you a complete line of high quality systems and components for better TV pictures and brighter sales pictures!

**You can sell a complete line of**

- All-Channel TV and FM Antennas
- Area Special Antennas for your location
- Hi-Carbon Golden Masts . . . telescoping or straight lengths
- Distribution Amplifiers and Systems
- Antenna Mounted Amplifiers and Couplers
- All related equipment including: Splitters, Couplers, Mixers, Wall-Taps and Drop-Taps.

*Every Kay-Townes product is field tested, performance proved . . . and designed and manufactured in the U.S.A.*

**WRITE NOW FOR OUR COMPLETELY NEW MATV AND ANTENNA CATALOGS!**

**KAY-TOWNES**
**P.O. Box 593**
**Rome, Georgia 30161**
**Phone: (404) 235-0141**

*Circle 34 on literature card*

munications, audio, hi-fi industrial electronics, including their 1971 catalog of technical books about every phase of electronics.*

131. *Sylvania Electric Products, Inc., Sylvania Electronic Components Div.* — has published the 14th edition of their technical manual, which includes mechanical and electrical ratings for receiving tubes, television picture tubes and solid-state devices. Price of this manual is $1.90.*

132. *Tab Books* — has released their Spring, 1971 catalog describing over 170 current and forthcoming books. The 20-page catalog covers: schematic/servicing manuals, broadcasting; basic technology; CATV; electric motors; electronic engineering; computer technology; reference; television, radio and electronics servicing; audio and hi-fi stereo; hobby and experiment; amateur radio; test instruments; appliance repair, and transistor technology.

**TEST EQUIPMENT**

133. *B & K Mfg. Div., Dynascan Corp.*—is making available an illustrated, 24-page 2-color Catalog BK-71, featuring B & K test equipment, with charts, patterns and full descriptive details and specifications included.*

134. *Eico* — has released a 32-page, 1971 catalog which features 12 new products in their test equipment line, plus a 7-page listing of authorized Eico dealers.

135. *Leader Instruments Corp.* —announces the 1971 Catalog of Leader Test Equipment. Test equipment included is the LBO-301 portable triggered-sweep oscilloscope, LSW-330 new solid-state post injection sweep/marker generator, and the LCG-384 miniportable, solid-state battery operated color-bar generator*.

**TOOLS**

136. *Xcelite, Inc.* — has published a 2-page illustrated Bulletin N670, which introduces two new reversible ratcheting handles for use with more than 60 of the company's available Series "99" nutdriver, screwdriver and special purpose blades.*

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

# 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.

**EQUIPMENT FOR SALE**

Triplett 8000-A, Digital Volt Ohm Milliammeter, new with warranty card $595.00. R-K Electronics, 1428 Ormond Street, Lansing, Michigan 48906. 8-71-1t

Tektronix 561A Oscilloscope with plugins 3A1, 63 and 3B3, $1230.00. R-K Electronics, 1428 Ormond Street, Lansing, Michigan 48906. 8-71-1t

For Sale: C-G3 Lab grade frequency counter with converters, mint condition, very reasonable. John Perkovich, Route 1, Cascade, Wisc. 53011. 8-71-1t

YEATS
handles SHORT or TALL appliances with non-slip grip!
MOST VERSATILE APPLIANCE TRUCK DEVELOPED!

YEATS Model No. 5 $66.50
FREE illustrated brochure
YEATS APPLIANCE DOLLY SALES CO.
1300 W. FOND DU LAC AVE.
MILWAUKEE, WIS. 53205

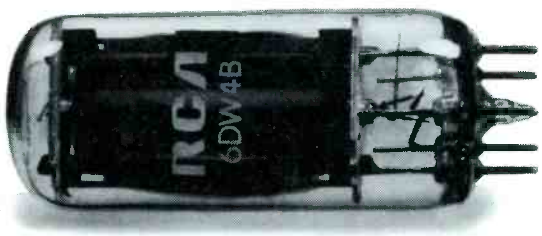
*Circle 33 on literature card*

# advertisers' index

# Cut arc-back in TV damper circuits with RCA tubes...

| | |
|---|---|
| 6AF3 | 6CL3 |
| 6AY3B | 6DW4B |
| 6BS3A | 17AY3A |
| 6CG3/6BW3 | 17BE3/17BZ3 |
| 6CJ3/6CH3 | 17BS3A/17DW4A |

## All have the pre-coated cathode!




These are the 10 most popular industry types for TV damper circuits. The cathodes in these RCA tubes are pre-coated to reduce arcing.

A special manufacturing process pre-coats the cathode and pressure-welds the coating. This produces a smooth, uniform surface that virtually eliminates arcing.

In every way, the quality that goes into these tubes backs up your reputation for quality work. Systematic parts inspection, tough environmental testing, sample life testing . . . these are some of the ways we build quality in and then check it out.

See your RCA tube distributor for the complete line of RCA tubes for damper circuits, high-voltage circuits and all your other tube needs.

RCA | Electronic Components | Harrison, N.J. 07029.

RCA

# THE SAFEST SETS YOU'LL EVER SERVICE HAVE LITTELFUSE CIRCUIT BREAKERS.


| Standard Catalog Part No. | Hold Rating (Amps.) | Standard Catalog Part No. | Hold Rating (Amps.) |
|---|---|---|---|
| 815.650 | .490 | 8152.75 | 1.92 |
| 815.800 | .600 | 815003 | 2.1 |
| 815001 | .650 | 8153.25 | 2.2 |
| 8151.25 | .930 | 815004 | 2.5 |
| 81501.5 | 1 | 81504.5 | 3 |
| 8151.75 | 1.2 | 815005 | 3.25 |
| 815002 | 1.4 | 815006 | 3.9 |
| 8152.25 | 1.5 | 815007 | 4.14 |
| 81502.5 | 1.65 | | |

Littelfuse TV set circuit breakers are the safe, reliable, money saving short-circuit-problem-solvers . . . 17 available models—exact replacements—cover the entire range of domestic television sets.

Littelfuse circuit breakers are available from your distributor—singly or in bulk.

Super-simple in operation—the sensitive breaker flips open under current overloads protecting the circuitry. Reset by merely pressing the red reset plunger. A built-in "trip free" feature of Littelfuse breakers prevents forced closing when dangerous overload currents are present.

Nothing's more reliable than a Littelfuse circuit breaker. Thermal-responsive Littelfuse breakers are dual operated bi-metallic devices providing temperature compensation over a wide range of ambient temperature variation. Molded phenolic construction eliminates warping and distortion of the base, maintaining exact factory set calibrations. The unit is completely enclosed to protect critical moving parts from dirt and other foreign matter.

Any TV set you're likely to service will take Littelfuse circuit breakers.

They'll flip for safety.

You'll flip for satisfaction.

# LITTELFUSE

DES PLAINES, ILLINOIS 60016

SUBSIDIARY OF TRACOR, INC.

*Circle 3 on literature card*

MR HOWARD ERICKSON
BOX 94
BARK RIVER MICH 49807