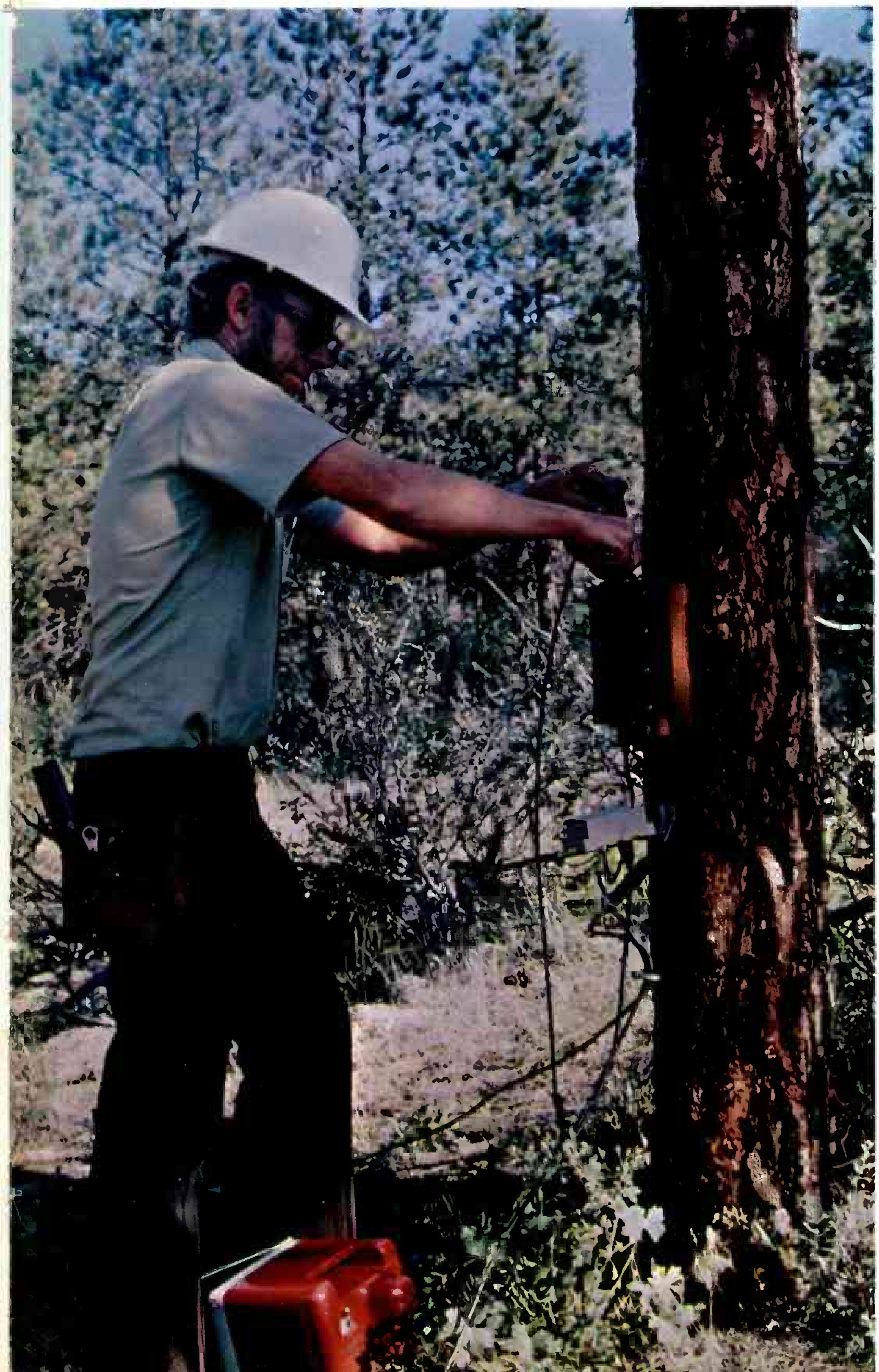
October, 1976 ☐ 75 cents

Electronic Servicing

A HOWARD W. SAMS PUBLICATION



MATV BY THE FOOT!

General Electric Horizontal

Pricing Your Hourly Rate

THE COMPLETE LIST OF ALL PTS SERVICE CENTERS APPEARS ON THE NEXT PAGE.

October, 1976 □ Volume 26, No. 10

Electronic Servicing®

in this issue...

ABOUT THE COVER

Wayne Benbow connects CLA's and cable up high on the Colorado mountain that shields the TV signals.

DEPARTMENTS

Second class postage paid at Shawnee Mission, Kansas and additional mailing offices. Published monthly at 9221 Quivira Road, Overland Park, Kansas 66212 by Intertec Publishing Corp., 9221 Quivira Road, Overland Park, Kansas 66212. Send Form 3579 to 9221 Quivira Road, P.O. Box 12901, Overland Park, Kansas 66212.

Electronic Servicing

Editorial, advertising and circulation correspondence should be addressed to: 9221 Quivira Road, P.O. Box 12901, Overland Park, Kansas 66212 (a suburb of Kansas City, Missouri). (913) 888-4664

ABP

Member, American Business Press
Member, Audit Bureau of Circulations

ELECTRONIC SERVICING (with which is combined PF Reporter) is published monthly by Intertec Publishing Corp., 9221 Quivira Road, Overland Park, KS 66212.

ELECTRONIC SERVICING is edited for technicians who repair home-entertainment electronic equipment (such as TV, radio, tape, stereo, and record player), and for industrial technicians who repair defective production-line merchandise, test equipment, or industrial controls in factories.

Subscription Prices: 1 year—$6.00, 2 years—$10.00, 3 years—$13.00, in the U.S.A. and its possessions. All other foreign countries: 1 year—$7.00, 2 years—$12.00, 3 years—$16.00. Single copy 75 cents; back copies $1. Adjustment necessitated by subscription termination to single copy rate. Allow 4-6 weeks delivery for change of address. Allow 2-3 weeks for new subscriptions.

Robert E. Hertel, Publisher

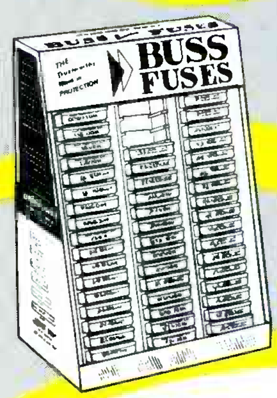
INTERTEC PUBLISHING CORP.
Subsidiary of HOWARD W. SAMS & CO., INC.

Buss® Fuses Specialize Too!

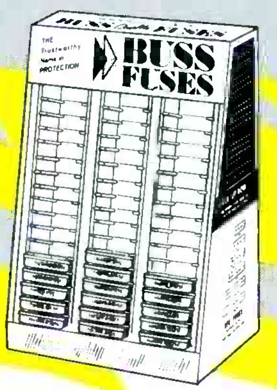
in the protection of

CB

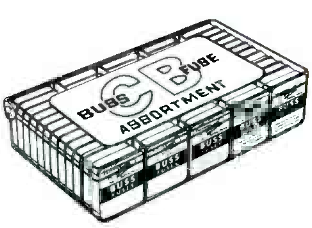
EQUIPMENT



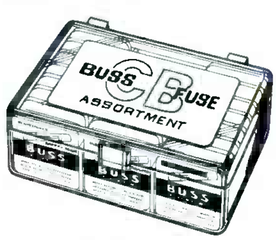
No. 240CB-3
Metal Display Stand



No. 80CB-1
Metal Display Stand



No. 240CB-4
Plastic Display Box



No. 80CB-2
Plastic Display Box

Now . . . four new BUSS fuse assortments exclusively designed with replacement fuses to service most Citizen Band Radios — offering a whole new area of opportunities for increased profits.

Two assortments contain 48 — 5 in metal boxes (240 fuses). BUSS No. 240CB-3 fuse assortment comes in a handy metal display stand. BUSS No. 240CB-4 fuse assortment is packed in a compact plastic display box.

In addition, there are two fuse assortments containing 16 — 5 in metal boxes (80 fuses). BUSS No. 80CB-1 fuse assortment packed in a metal display stand and BUSS No. 80CB-2 fuse assortment in a plastic display box.

Both BUSS fuse assortments contain a careful selection of the most popular fuses used in CB radios.

CB dealers can now have the fuses they need in a neat complete package to service all their customers fuse needs.

For full fuse assortment details, write for BUSS Bulletin CBA.

BUSSMANN MANUFACTURING
a McGraw-Edison Company Division
St. Louis, Missouri 63107

SUPPLIED THE ECONOMICAL WAY THRU DISTRIBUTORS
BUSS® FUSES
THE QUALITY LINE

electronicscanner

news of the industry

Strands of glass make up one link of the CATV system that serves 34,000 subscribers in the Hastings area of England. A 4700-foot section of optical cable designed by Corning Glass Works now is in operation. The video signals are changed to light in a Plessey gallium-arsenide light-emitting diode (LED) and, at the other end, a photodiode changes the variations of light intensity back into electrical signals again. Advantages claimed for the glass cable include the transmission of more information in smaller and lighter cables, plus no electrical interference.

Litton Microwave Cooking Products is building a new $5.5 million plant in Sioux Falls, South Dakota. This will double Litton's production of countertop microwave ovens. Other sources estimate that the present 6% saturation level of microwave sales will zoom to 40% within the next five years.

During September, the Federal Communications Commission (FCC) started processing applications for type-acceptance of the 40-channel CB radios which will be legal by January 1. Also, the FCC is not opposing the factory modification to 40-channel specifications; however, any external attachments to extend the frequency range are forbidden. The reason is said to be the need to minimize radiation interference. Congress recently appropriated an additional $3.2 million for the FCC, and this is expected to end the FCC hiring freeze.

Most new 40-channel CB radios are expected to use the phase-locked loop type of frequency synthesis. Such systems have two or three crystals for 40 channels, compared to perhaps 14 for 23 channels with the present types of synthesizers.

The FCC has proposed that each TV receiver having a factory-installed VHF antenna also should have a UHF antenna attached. This is in line with the desire to make UHF equal to VHF in convenience and quality of reception.

A race might be beginning to increase the playing time of video-cassette recorders from one hour to two. The Victor Company of Japan has announced a two-hour ½-inch tape video cassette to be sold for about $1,000. Sony is said to have both two-hour and three-hour versions which are compatible with the present Sony Betamax machines. It is not likely Sony will introduce the longer-playing versions in America, unless forced by competition from Victor.

CB radio continues to be a battleground. The Association Of Maximum Service Telecasters (AMST) has requested the FCC to reconsider the 60 dB harmonic suppression specification for the 40-channel radios, stating it needs to be increased to 110 dB to protect television reception from CB interference. Previously, according to **Retailing Home Furnishings,** the Electronic Industries Association (EIA) has asked for more lenient specifications. The CB industry seems to be in for a period of uncertainty, at a time when retail sales have been reduced by the promise of the 40-channel radios next January.

Hitachi Research Laboratory has developed a simplified optical system for video discs. Hitachi says the conventional systems use a helium-neon laser of large size and a complex optical path with mirrors and lenses, requiring separate light paths for the servo and video signals. The Hitachi system has a semi-conductor laser and

(Continued on page 6)

Cash in on the booming CB repair business. Get your Mallory big-profit package now.

It's an introductory offer with an unbeatable combination.

A huge assortment. With the Mallory CB parts replacement package, you can service the electronics in almost every type of CB radio made. Because, unlike limited-coverage programs, you get more than 370 of the most commonly used semiconductor and other replacement parts.

And a hefty discount off column pricing. Which can add up to a whopping profit in CB repair — up to 25 times the cost of the parts to you.

Plus, free Mallobin® cabinets, the great space-saving organizers — seven rugged plastic 15-drawer units with each Mallory CB package you buy. And a free CB Component Cross-Reference booklet covering the semiconductors and controls used by the major manufacturers of CB radios.

What a deal for a very modest investment. Under $200, in fact. It's a profit opportunity you just can't afford to pass up.

Act now. Fill in and mail the coupon today.

TO: Dept. 103, Mallory Distributor Products Co.
Box 1284, Indianapolis, IN 46206

☐ I want to take advantage of your introductory offer now. Send one complete CB replacement package through my Mallory distributor. It is my understanding that I will be billed by my Mallory distributor.

☐ Send more information on the Mallory CB profit package.

Name ____________________

Company ____________________

Address ____________________

City ____________ State ________ Zip ________

Telephone ____________________

MALLORY

MALLORY DISTRIBUTOR PRODUCTS COMPANY

a division of P. R. MALLORY & CO. INC.
Box 1284, Indianapolis, Indiana 46206; Telephone: 317-856-3731

Batteries • Capacitors • Controls • Security Products • DURATAPE® • Resistors • Semiconductors • SONALERT® • Switches • Fastening Devices

DURATAPE® and SONALERT® are registered trademarks of P. R. Mallory & Co. Inc.

For More Details Circle (14) on Reply Card

(Continued from page 4)

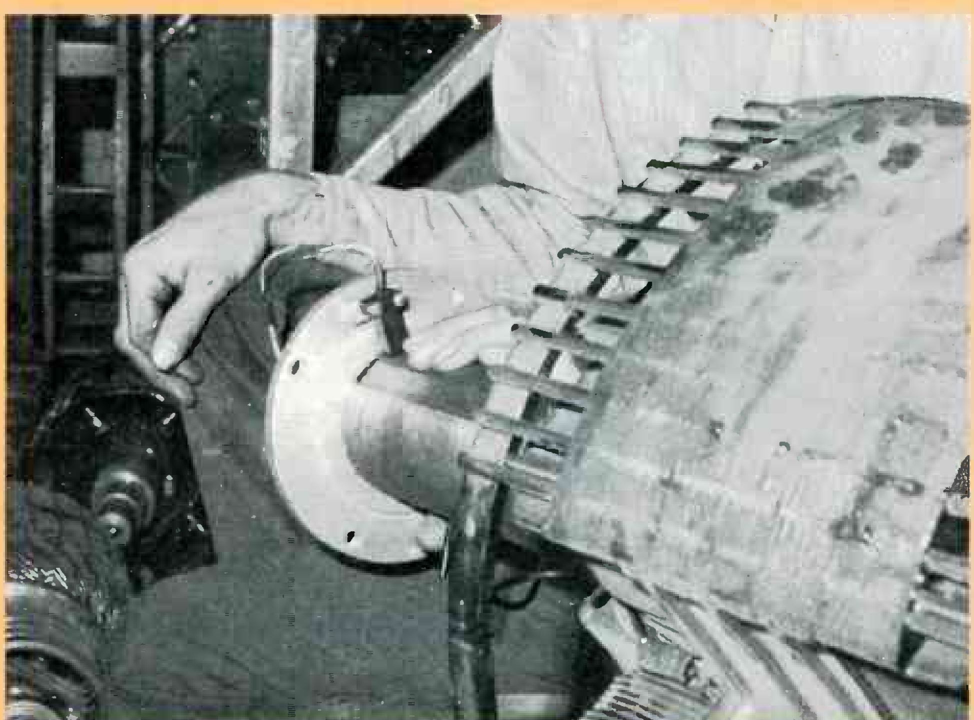
optics that bring the video and servo beams into one axis. A signal-to-noise-ratio of 40 dB is claimed.

Carbon-dioxide gas now is being used in many of the tuner sprays manufactured by Chemtronics. Formerly, Freon-12 was the propellant of all sprays. Although Chemtronics President, Al Friedman, does not agree with the environmentalists who believe freon will deplete the ozone layer of the atmosphere, he points out other advantages of carbon-dioxide sprays. The carbon-dioxide gas is more powerful, so it occupies a smaller space in the cans, leaving more room for the active ingredients. Also, carbon-dioxide sprays are warmer than freon, which is a refrigerant. Of course, carbon-dioxide gas is non-toxic, non-flammable, and safe for use on plastics.

Lloyd's Electronics and Capehart Corporation recently announced an agreement for Lloyd's to buy the assets of Capehart. It is planned that the Capehart operations would be continued by a newly-formed subsidiary. Lloyd's imports, assembles, and markets home and portable electronic entertainment products. Capehart manufactures and markets moderately-priced stereo consoles and component systems.

Solve your test rig yoke-adapter problems by calling Bernie Shofler at 212/345-4235. Mr. Shofler, Chief Engineer of TeleMatic, has compiled data for thousands of matches between all color-TV chassis and any brand of test rig, and he will provide no-charge advice. Or, write to TeleMatic at 2849 Fulton Street, Brooklyn, New York 11207 for a free cross-reference chart.

A tiny inch-long solid-state sensor protects against excessive speed of a large 250-kilowatt Kohler AC generator. The sensor manufactured by MICRO SWITCH monitors the position of the keyway in the driveshaft, and the controller shuts down the system if the shaft speed exceeds 1800 RPM's.



TUNER SERVICE CORPORATION

SUBSTITUNER

JUST

$44^95

U.S.A. ONLY

WITH CABLES

ONE YEAR GUARANTEE

STILL ONLY

$9^95

U.S.A. ONLY

MAJOR PARTS AND SHIPPING CHARGED AT COST

FEATURES

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

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

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

NEWS FLASH!

NOW AVAILABLE—TUNER SERVICE PARTS CATALOG OF ALL SARKES TARZIAN VHF AND UHF TUNERS, INCLUDING EXPLODED VIEW DRAWINGS. OVER 200 PAGES. ORDER YOUR COPY TODAY. *SEND $2.50 WITH ORDER TO BLOOMINGTON HEAD OFFICE.*

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

REPAIR

VHF OR UHF ANY TYPE ...... (U.S.A. ONLY) $ 9.95
UHF/VHF COMBINATION .... (U.S.A. ONLY) $15.00

MAJOR PARTS AND SHIPPING CHARGED AT COST

- Fast, efficient service at our conveniently located Service Centers.
- All tuners are ultrasonically cleaned, repaired, realigned, and air tested.

REPLACE

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

- This price buys you a complete new tuner built specifically by Sarkes Tarzian Inc. for this purpose.
- All shafts have a maximum length of 10½" which can be cut to 1½".
- Specify heater type parallel and series 450 mA. or 600 mA.

CUSTOMIZE

- Customized tuners are available at a cost of only $15.95. With trade-in $13.95. (U.S.A. only)
- Send in your original tuner for comparison purposes to any of the Centers listed below.

HEADQUARTERS	BLOOMINGTON, INDIANA 47401	537 South Walnut Street	Tel. 812-334-0411
ARIZONA	TUCSON, ARIZONA 85713	1528 S. 6th Ave.	Tel. 602-791-9243
CALIFORNIA	NORTH HOLLYWOOD, CALIF. 91601	10654 Magnolia Boulevard	Tel. 213-769-2720
	SAN MATEO, CALIF. 94402	600 S. Amphlett Blvd.	Tel. 415/348-3292
	MODESTO, CALIF. 95351	123 Phoenix Avenue	Tel. 209-521-8051
FLORIDA	TAMPA, FLORIDA 33606	1505 Cypress Street	Tel. 813-253-0324
	FT. LAUDERDALE, FLORIDA 33315	104 S.W. 23rd St., Bay 6	Tel. 305-524-0914
GEORGIA	ATLANTA, GA. 30310	646 Evans St. S.W.	Tel. 404-758-2232
ILLINOIS	URBANA, ILLINOIS 61820	908 E. Main Street	Tel. 217-384-2052
	DOLTON, ILL. 60419	1507-09 E. 142nd St.	Tel. 312/841-4444
	SKOKIE, ILLINOIS 60076	5110 West Brown Street	Tel. 312-675-0230
INDIANA	INDIANAPOLIS, INDIANA 46204	112 West St. Clair Street	Tel. 317-632-3493
KENTUCKY	LOUISVILLE, KENTUCKY 40205	2244 Taylorsville Road	Tel. 502-452-1191
LOUISIANA	SHREVEPORT, LOUISIANA 71104	3025 Highland Avenue	Tel. 318-221-3027
MARYLAND	BALTIMORE, MARYLAND 21215	5505 Reisterstown Rd., Box 2624	Tel. 301-358-1186
MASSACHUSETTS	SPRINGFIELD, MASS. 01108	405 Dickinson St.	Tel. 413-788-8206
MISSOURI	ST. LOUIS, MISSOURI 63132	9577 Page Avenue	Tel. 314-429-0633
NEVADA	LAS VEGAS, NEVADA 89102	1412 Western Avenue	Tel. 702-384-4235
NEW JERSEY	TRENTON, NEW JERSEY 08638	1139 Pennsylvania Ave.	Tel. 609-393-0999
	JERSEY CITY, NEW JERSEY 07307	547-49 Tonnele Ave., Hwy. 1 & 9	Tel. 201-792-3730
NEW YORK	ROCHESTER, NEW YORK 14615	37 Pullman Ave.	Tel. 716-647-9180
N. CAROLINA	GREENSBORO, N.C. 27405	2914 E. Market Street	Tel. 919-273-6276
OHIO	CINCINNATI, OHIO 45216	7450 Vine Street	Tel. 513-821-5080
	CLEVELAND, OHIO 44109	4525 Pearl Road	Tel. 216-741-2314
OREGON	PORTLAND, OREGON 97210	1732 N.W. 25th Ave., P.O. Box 10141	Tel. 503-222-9059
PENNSYLVANIA	PITTSBURGH, PA. 15209	515 Grant Avenue	Tel. 412-821-4004
TENNESSEE	MEMPHIS, TENNESSEE 38111	3158 Barron Avenue	Tel. 901-458-2355
TEXAS	DALLAS, TEXAS 75218	11540 Garland Road	Tel. 214-327-8413
VIRGINIA	NORFOLK, VIRGINIA 23513	3295 Santos Street	Tel. 804-855-2518
CANADA	ST. LAURENT, QUEBEC H4N-2L7	305 Decarie Boulevard	Tel. 514-748-8803
	CALGARY, ALBERTA T2H-1Y3	P.O. Box 5823, Stn. "A"	Tel. 403-243-0971

TSC

WATCH US GROW

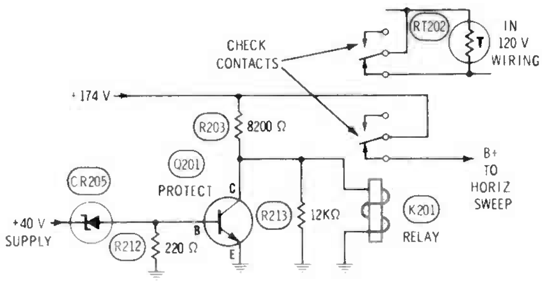
IF YOU WANT TO BRANCH OUT INTO THE TV TUNER REPAIR BUSINESS, WRITE TO THE BLOOMINGTON HEADQUARTERS ABOUT A FRANCHISE.

For More Details Circle (15) on Reply Card

symcure

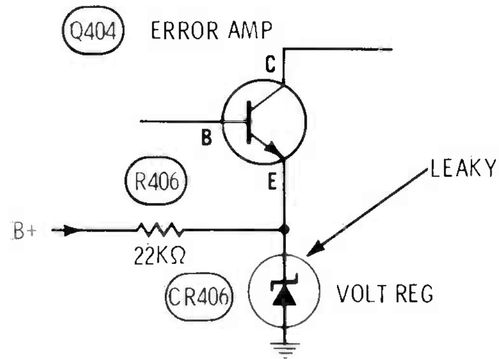
Symptoms and cures compiled from field reports of recurring troubles

Chassis—RCA CTC74
PHOTOFACT—1568-1



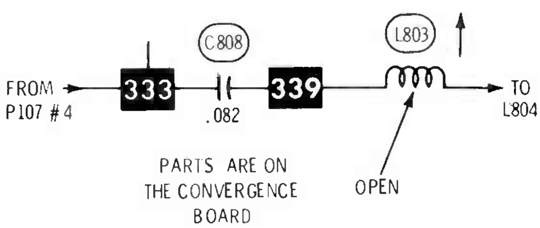
Symptom—1" narrow width; intermittent
Cure—Jumper relay contacts as a test; replace relay if contacts are intermittent (contacts closed when TV is on)

Chassis—RCA CTC76
PHOTOFACT—1519-2



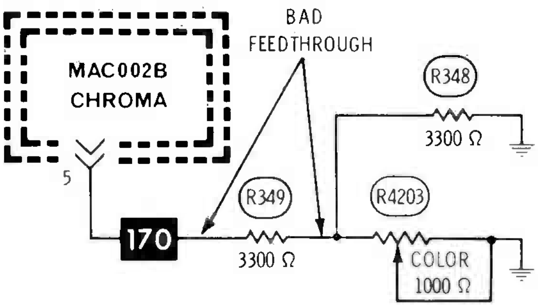
Symptom—Insufficient width
Cure—Check zener diode CR406, and replace it if leaky

Chassis—RCA CTC68
PHOTOFACT—1437-2



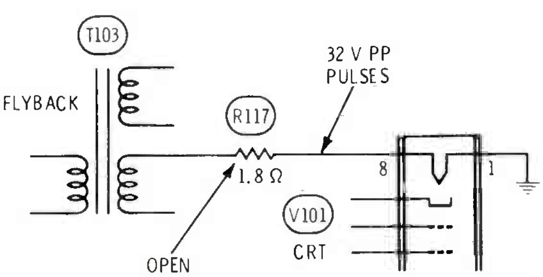
Symptom—Poor convergence at both edges of picture
Cure—Check L803 on convergence board, and replace it if open

Chassis—RCA CTC58
PHOTOFACT—1365-1 (1428-2)



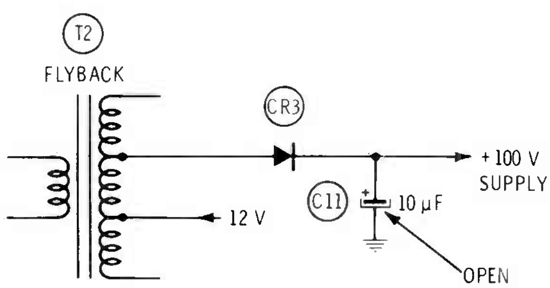
Symptom—Intermittent color saturation
Cure—Check feedthrough at R349, and resolder if loose

Chassis—RCA KCS202 (b-w TV)
PHOTOFACT—1523-1



Symptom—Heater of picture tube not lit
Cure—Check R117, and replace it if open

Chassis—RCA KCK185 (b-w TV)
PHOTOFACT—1170-2



Symptom—Poor vertical locking; 100-volt supply is low
Cure—Check C11, and replace it if open

troubleshooting tips

Send in your helpful tips—we pay!

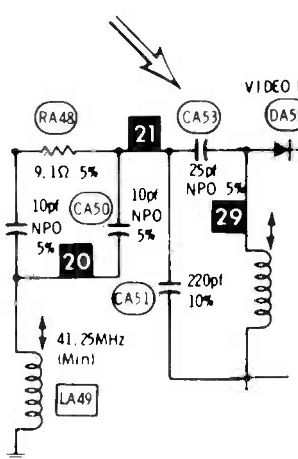
No video, but sound and raster are okay
Admiral K-10 chassis
(Photofact 1392-1)

Loss of video, but with strong sound and normal raster, often points to a defect in the video IF stages. Most color receivers have separate takeoff of the sound signal without going through the video detector. Also, the sound often comes through IF's which are too weak to show a picture.

When I injected a video signal from a B&K color generator at the base of the first video amplifier, a strong pattern could be seen on the screen. This proved the circuits from the video amplifier to the picture tube were okay.

Video-detector diodes are a frequent cause of these symptoms. However, I installed a new one, without any change.

DC voltage measurements in the IF stages found nothing suspicious. Signal injection from the generator to the base and collectors of Q1, Q2, and Q3 of the IF's produced no pattern on the picture tube.



Remembering the cases with RCA CTC38 chassis where replacements of the third IF transistors were necessary, even without any test that indicated a problem, I installed a new transistor. No change; the raster remained blank.

Next, I checked the continuity of the coils and other components of the video-detector circuit. Nothing appeared to be open, but when I

(*Continued on page 16*)


Get in on the
CB Service BOOM
with the B&K Test Bench

WITH THE MODEL 1040 CB SERVICEMASTER IT'S EASY, IT'S FAST AND IT'S PROFITABLE.

MODEL 1040
$250

The B&K-PRECISION CB Servicemaster is designed for rapid programmed testing and trouble shooting of any CB transceiver.

It functions as a test center and enables you to quickly check all of the significant performance characteristics of the transceiver with one hook-up—*in a matter of minutes.*

When used with a scope and signal generator, you can:

- **Measure signal-to-noise ratio of CB receiver**
- **Measure audio output power**
- **Measure audio distortion percentage**
- **Measure receiver sensitivity**
- **Check AGC**
- **Measure effectiveness of CB noise limiter or blanker (when used with an impulse noise generator)**
- **Measure squelch threshold**
- **Measure adjacent channel rejection**
- **Measure transmitter AM power output—even mobile!**
- **Measure SSB power output with TRUE peak-reading RF Wattmeter**
- **Check AM modulation**
- **Check SSB modulation with a two-tone test—the only accurate way!**
- **Measure antenna SWR—even mobile!**
- **Check the transceiver in the car to determine if the problem is in the antenna system or the transceiver**

You can save $500—$1,500 in equipment costs because the CB Servicemaster eliminates many of the test instruments you would otherwise need for CB servicing. These instruments, or their functions, are built into the unit:

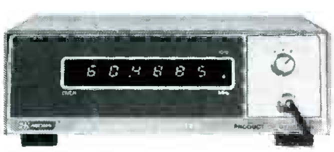
Audio wattmeter
Audio generator
Distortion meter
RF wattmeter/dummy load
DB meter
SWR bridge

A built-in transmit mixer circuit converts a safe level of 27 MHz input signal down to approximately 1 MHz for scope display, allowing you to display the modulated RF signal on a 2 MHz scope!

These instruments—which you should have, if you don't own them already, are all you need to get the maximum use from your CB Servicemaster. And the B&K CB Servicemaster is compatible with most oscilloscopes, frequency counters, signal generators and power supplies on the market today.

MODEL 1403A—3", 5 MHz Recurrent Sweep Oscilloscope
Checks CB modulation and provides viewing of 27MHz CB envelope when used with the Model 1040. Small, compact and inexpensive, it frees other scopes for more effective use.
Model 1403A $209

MODEL 1640—Regulated Power Supply
Designed especially for CB and other mobile equipment, the 1640 eliminates changes in supply voltage due to load variations. A stable power supply is essential to precise testing of the transceivers. Less than 0.8% variation from zero to full load, 3 amps continuous, 5 amps surge. Adjustable to any output from 11 to 15 VDC. Suppressed zero scale for greater accuracy. Overload protected.
Model 1640 $100



MODEL 1801—Digital Frequency Counter
To quickly determine the exact frequency of a CB channel, the 1801 automatically displays it for you in large, easy-to-read digits. You can tune oscillators precisely, conduct audio frequency analysis tests. Six digit display is updated five times per second. Accuracy guaranteed to 40MHz; 60MHz typical.
Model 1801 $240

MODEL 2040—40 Channel CB Signal Generator
Covers all 40 authorized channels. AM and SSB and ten adjacent unassigned channels. Ultra-stable crystal-controlled, phase-locked-loop frequency generation. Has 5 ppm accuracy. Output attenuator and vernier provide calibrated outputs from 100,000 μV to 0.1 μV for receiver sensitivity measurements. Includes EIA standard noise test signal generator to check receiver noise suppression. Internal 400, 1000 and 2500 Hz modulating frequencies—can also be externally modulated. Internal protection against 5W RF input.
Model 2040 $475

For additional information, contact your B&K-PRECISION distributor for our comprehensive brochure describing the operation of the Model 1040 CB Servicemaster and the CB Service Center—or write us for your free copy.

B+K PRECISION
DYNASCAN CORPORATION
Makers of Cobra CB Equipment
6460 W. Cortland Avenue
Chicago, IL 60635 312/889-9087
In Canada: Atlas Electronics, Toronto

7623C

For More Details Circle (18) on Reply Card

NEWS from the Service Associations

Newly-elected NATESA officials are (left to right): Richard Ebare, treasurer; Paul Kelley, vice-president; Leo Cloutier, secretary-general; George Weiss, president; and Frank Moch, executive director.

NATESA Convention—Attendance at the 1976 NATESA convention (August 19-22 in Pheasant Run Lodge) exceeded by about 20% the attendance of the past two conventions. Meals and public speakers were furnished by GTE-Sylvania, Magnavox, GE, Zenith, RCA, and Sony.

Joe Groves, Photofact Manager, hosted the customary cocktail party by Howard W. Sams. Zenith received the "1976 NATESA Friends Of Service Award". Several men took the Technician Certification test and, later in the day, certificates were presented to 10 technicians.

A Business-Practices Panel answered questions from the delegates. Lee Fein presented a Security Seminar, B&K Dynascan gave a seminar about CB, VIR Broadcast Control was demonstrated by General Electric, A Beta-Max video-tape presentation was given by Sony, and Carl Babcoke (Editor of Electronic Servicing) spoke about new tools, equipment, and techniques for servicing color receivers. Quasar Corporation supplied a 25" color television as an attendance award.

NATESA is to be changed from an alliance of local associations to an association of individual members. Reason for the important change was said to be the former total autonomy of the local associations which barred NATESA from accepting individual members, even when the locals failed to achieve reasonable growth, or disintegrated. The proposed new name is "National Association Of Television And Electronic Servicers Of America". The logo and acronym remain the same. *NATESA, 5908 South Troy Street, Chicago, Illinois 60629*

(Continued on page 17)

(Continued from page 9)

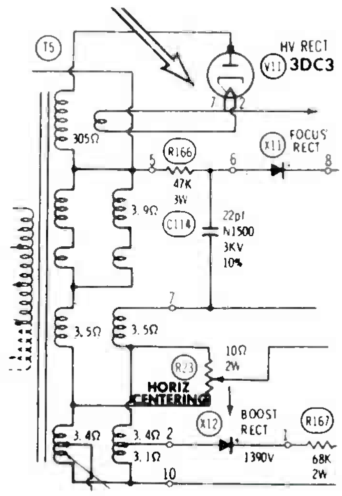
paralleled CA53 with a 25 picofarad capacitor, the color picture appeared. Installation of a new capacitor completed the repair.

Jack S. Connell, CET
Houston, Texas

Low HV
Zenith 14A9C50 chassis
(Photofact 1097-3)

The high voltage measured only about 5 KV, instead of the usual 25 KV. I checked the drive at the grid of the horizontal-output tube and the focus voltage. They were normal, and I suspected the high-voltage rectifier right then, because the focus comes from a separate diode.

When I removed the plate cap of the HV-rectifier tube, the AC arc indicated plenty of voltage. Someone had replaced the 3DC3 with a 3A3, and it checked "good". I checked the filament wiring and found no shorts, opens, or any evidence of arcs. Logically, the DC high voltage should be operating. Another 3A3/3B2 gave the same results.



I began tracing the circuit in the Photofact, and the light began to dawn. After I added a jumper from pin 1 to pin 7 of the rectifier socket, the high voltage came on in full force.

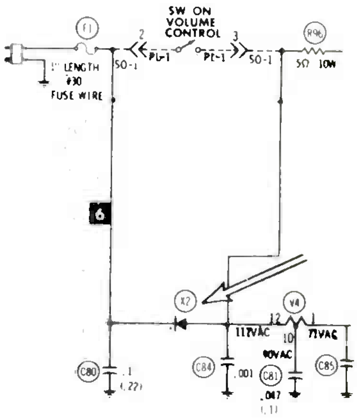
Zenith had wired the socket for 3DC3 or 3DB3, and a 3AC3 also would have worked, because it has internal jumpers between pins 1, 3, 5, and 7. But the 3A3 did not, and could not work until the circuit was modified.

I recommend adding this jumper to any other similar rectifier socket, so any of those types will work.

Edna Bailey
Boring, Oregon

TV would not shut off
Emerson Model 22BC01W (b-w)
(Photofact 1222-1)

One of my regular customers turned off her TV, and went to bed for the night. Next morning, she was startled to find the TV had a picture. She reasoned that she must



have forgotten to switch it off, but the switch was in the "off" position. Finally, she unplugged the AC cable from the wall and brought the portable TV to my shop.

First, I checked the on/off switch, which is a double-pole/single-throw type, but it operated okay. After more tests, I found that diode X2 was shorted. Since it paralleled the main switch, this applied the AC power all the time.

Diode X2 is supplied to keep the tube heaters partially hot so the picture can be seen very soon after turn-on. It normally produces half-wave unfiltered **negative** DC voltage, which cannot go through X1, the main low-voltage rectifier.

Evidently, a voltage transient from a thunderstorm had shorted the diode, for the replacement I installed is operating fine.

Charlie Jackson
Buckner, Illinois

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

Service Assn. News
(Continued from page 12)

NESDA—San Antonio, Texas (home of the Alamo and many historic missions) was the location of the 4th annual (and largest) convention of NESDA, August 13-17, 1976. The 600 attendees represented more than 2000 NESDA members. One goal for the next year is to increase the membership by 500 dealer shops. Associations from New Mexico, Virginia, Florida, South Carolina, and Colorado became affiliated.

Miles Sterling and Jim Ballard detailed the new California warranty law and the continuing lawsuits with the manufacturers over warranty prices. Three concurrent Profitable Service Management (PSM) schools operated with a total of 12 instructors.

New Officers of NESDA are: Everett Pershing, president; Kurt Wertheim, senior vice-president; John McPherson, secretary; and Jack Kelly, treasurer. Immediate Past President is LeRoy Ragsdale, who also was voted the NESDA Outstanding Officer for 1976.

Dick Pavek (Tech Spray) and Miles Sterling (Electro TV) were co-recipients of the NESDA Man Of The Year Award. Norris Browne, who died last year, was inducted into the Electronics Hall Of Fame. TEA members, under the direction of J. W. Williams, Kurt Wertheim, and George Simpson, hosted the convention.

ISCET, the NESDA technician affiliate, presented seminars by Stan Prentiss, Forest Belt, Carl Babcoke, John Sperry, Joe Groves, and Chuck Anderson. *National Electronic Service Dealers Association, 1715 West Expo Lane, Indianapolis, Indiana 46224.*

These are the new officers of the International Society Of Certified Electronic Technicians (ISCET), listed from left to right: Frank Grabiec, vice-president; Charles Couch, president; Carl Babcoke (editor of Electronic Servicing), secretary; and George Sopocko, treasurer.

Everret O. Pershing, of Pershing Radio & TV of Burbank, California, was elected president of the National Electronic Service Dealers Association (NESDA) at the convention last August in San Antonio, Texas. □

reader's exchange

There is no charge for listing in *Reader's Exchange*, but we reserve the right to edit all copy. If you can help with a request, write direct to the reader, *not to Electronic Servicing*.

For Sale: *Sencore PS29 Minute Man pushbutton automatic triggered scope. New in factory carton, never used. $450. Also, Sencore SS137 TV sweep-circuit analyzer, used twice, $75.*
Charles H. Shaw
9324 Brambly Lane
Alexandria, Virginia 22309

For Sale: *B&K TV analyst, Model 1096, excellent condition, in use one year, asking $150.*
Loren Miller
Rt. 1 Box 304
Minford, Ohio 45653

Needed: *Setup book for Model 157 tube tester (brand unknown). Will buy, or copy and return.*
Alfred Bartmess
324 Military
Baxter Springs, Kansas 66713

Needed: *Audio output transistor for Ford stereo auto radio. Number 879-274-CH7040.*
Don Vohar
P.O. Box 355
Ambridge, Pennsylvania 15003

Needed: *Schematic and operating instructions for a Win-Tronix dynamic sweep-circuit analyzer, Model 280 (manufactured by Winston Electronics, division of Jetronics Industries of Miami, Florida).*
John J. Marsh
55963 Onaga Trail
Yucca Valley, California 92284

Needed: *Pushbuttons and station-number plate for Zenith radio made in 1940 (Models 6S439 and 6S469; Chassis #5678). Will buy whole radio for parts, or any of the parts mentioned.*
John B. Stadler
131 Ormsby Avenue
Pittsburgh, Pennsylvania 15210

Needed: *Schematic and parts list, or any other data for an old E. H. Scott Laboratory AM/SW chrome/plated radio with a separate power supply. Serial number is B-262; no model number. Will buy, or copy and return.*
Raymond Friend
236 West Pearl Street
Butler, Pennsylvania 16001

For Sale: *Heathkit post-marker/sweep generator IG-57A. $180. Hewlett-Packard 350D attenuator; Thordarson Y48 100° yoke, replacement for RCA numbers 104482 (972958-3), 106142, 109695, 109070, 906122-501, and 972958-7.*

Wayne Vlieger
6610 S. High St.
Littleton, Colorado 80121

For Sale: *B&K Model 1077B TV analyst, excellent condition in original box, less than one year old. $350, or highest bidder.*

Clyde Chiever
Palestine Electronics
P.O. Box 62
Palestine, Texas 75801

For Sale: *Lectrotech TO-60 dual-trace, triggered-sweep scope, like new, 6 months factory warranty, low-cap probe PR10, demodulator probe PR12, and manual for $350. Also have B&K sweep/marker generator 415, all probes and manual; $250.*

C. W. Hume
108 Hillcrest Circle
Greenville, South Carolina 29609

Needed: *Schematic for Rhythm Ace FR-6, or address of Ace Electronics in Japan.*

Lektro-Tek
4102 S. Park Drive
Belleville, Illinois 62223

Needed: *Horizontal-output transformer for a Model BW-75 Milovac TV. Part number TDT608 or TDT605.*

Peter Golumbus
64 Coolidge Street
Irvington, New Jersey 07111

Needed: *Repair manual for Heyer scope and auto analyzer, Model #450-C.*

Jones Electronics
Rt. 1, Box 1549A
Yelm, Washington 98597

For Sale or Trade: *Sencore CG169 color generator.*

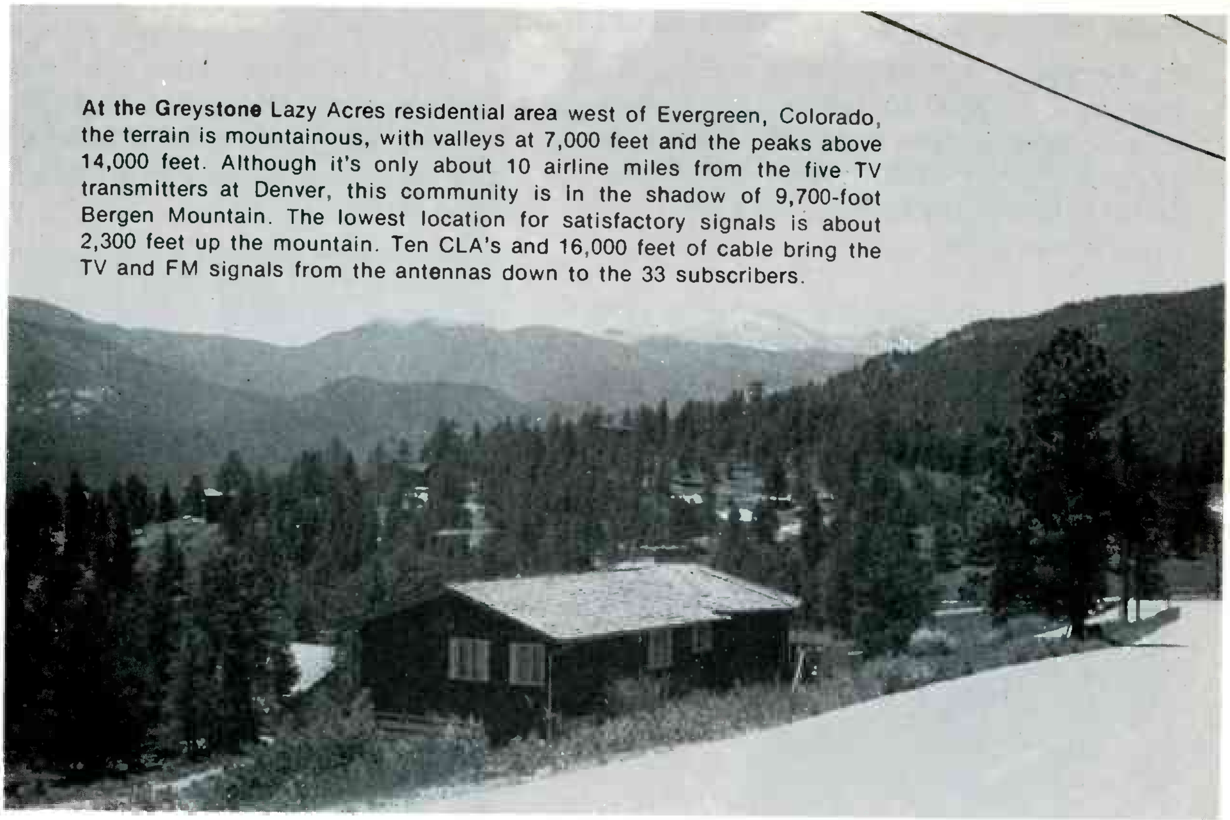
Norman Round
29 Elmwood Road
Methuen, Massachusetts 01844

Needed: *Manual and/or charts for Tequipco Model 3 in-circuit transistor and diode tester, manufactured in 1966.*

Frank's TV Service
47 Robertson Lane
Belleville, Ontario,
Canada K8P 4C2

For Sale: *Heathkit Model IG-57A post-marker generator; aligned, two months old, $160.*

K. Camp
Harding Highway RD #3
Elmer, New Jersey 08318



At the Greystone Lazy Acres residential area west of Evergreen, Colorado, the terrain is mountainous, with valleys at 7,000 feet and the peaks above 14,000 feet. Although it's only about 10 airline miles from the five TV transmitters at Denver, this community is in the shadow of 9,700-foot Bergen Mountain. The lowest location for satisfactory signals is about 2,300 feet up the mountain. Ten CLA's and 16,000 feet of cable bring the TV and FM signals from the antennas down to the 33 subscribers.

MATV By The Foot!

By James E. Kluge, Technical Editor, Winegard Company

Some problems are best solved with specialized equipment. An example is the MATV system requiring a long run of cable before the first tap-off. Constant-Level Amplifiers (CLA) from Winegard are designed to eliminate the calculations usually necessary for such systems.

If ever you have tried to design a large MATV trunk system, then you know the computations are many and tedious. Signal levels are converted from decibels to volts, and from volts to decibels. Gains or losses are added or subtracted, and the amount of frequency tilt must be determined to compensate for the cable losses or for the non-flat characteristics of other components. All of this is hard work, requiring much time (spelled "money").

Design By Distance

The Winegard Company has a new solution for those systems with long cable runs between tap-offs. At the heart of this concept is a type of line-extender amplifier called a Constant-Level Amplifier (CLA). These CLA's have internal compensation for both the loss and the tilt of a specific length of cable, so the computations are nearly zero.

Here is the principle: **Each CLA and the stated length of cable together form a unity-gain, flat-frequency-response signal module.**

For example, one type of CLA compensates for 400 feet of RG-11/U foam cable with UHF. Another compensates for VHF losses in 1000 feet of RG-6/U foam cable. A directional tap gives attentuation equal to 60 feet of cable, and other components similarly are rated in losses equal to a certain number of cable feet.

Therefore, you record the running total of cable and the insertion losses (converted to feet of cable) of passive components (such as taps, splitters, bridger amps, etc.) that have been installed since the last amplifier. After the losses (expressed in the number of feet of cable) equal the gain rating of the CLA, you install another CLA and continue in the same way.

Each amplifier automatically restores the original signal level and balance of the channels.

CLA versus cable type

Each type of coaxial cable has a different loss attenuation. Therefore, the length of cable between the CLA's will depend on the type of cable and the CLA following the cable.

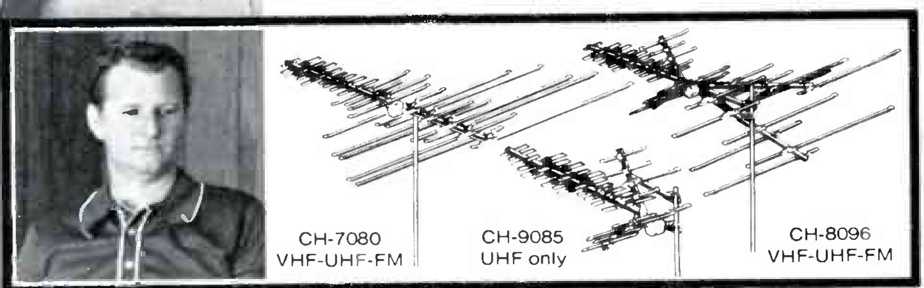
Bill Hughes of A-1 TV Service, Florida says:

Customers are asking us for Chromstar™

Bill Hughes' shop is in Niceville, Florida, just 12 miles from the Gulf Coast. Hughes states: "Even though Cable TV is in this area, I sell a lot of Chromstar antennas, many to people who put them up on their own. I help them select the right equipment needed, make all the connections on the antenna wire, and install a preamplifier in the cartridge housing if the customer desires." Hughes also provides customers with the Winegard brochure, "How To Install Your Own TV Antenna," as an added service. "Many customers ask specifically for Chromstar, having seen what it does for a neighbor's TV reception," Hughes explained. He adds, "Customers are happy with my service and with Chromstar, and I like the rugged construction and anodizing. I checked a Chromstar that was installed eight months before, and it still looks new. I've seen some antennas begin to corrode after just a few months, due to the sun and salt spray." Hughes is also happy with Chromstar preamps, which he says "can improve reception up to 35%."*

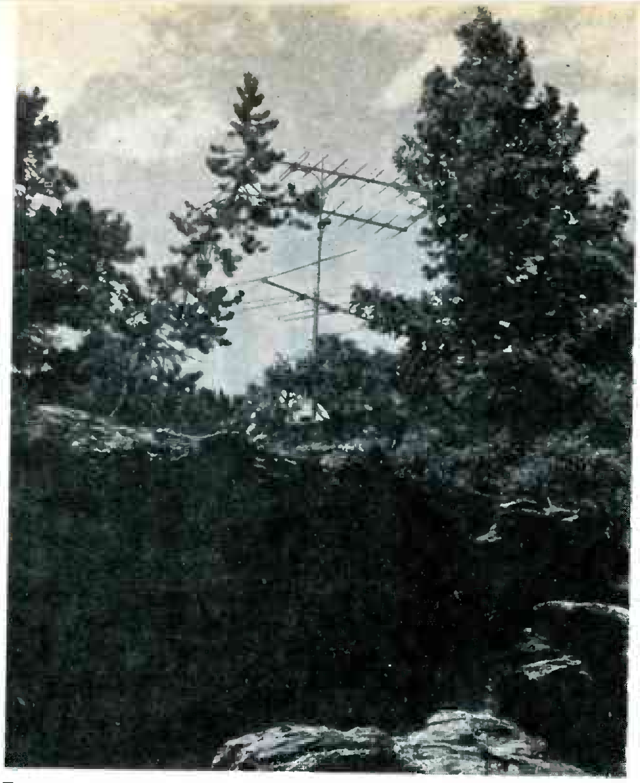
*A copy of Mr. Hughes statement will be sent to you upon your request.

Get complete product information and specification charts from your Winegard Distributor.

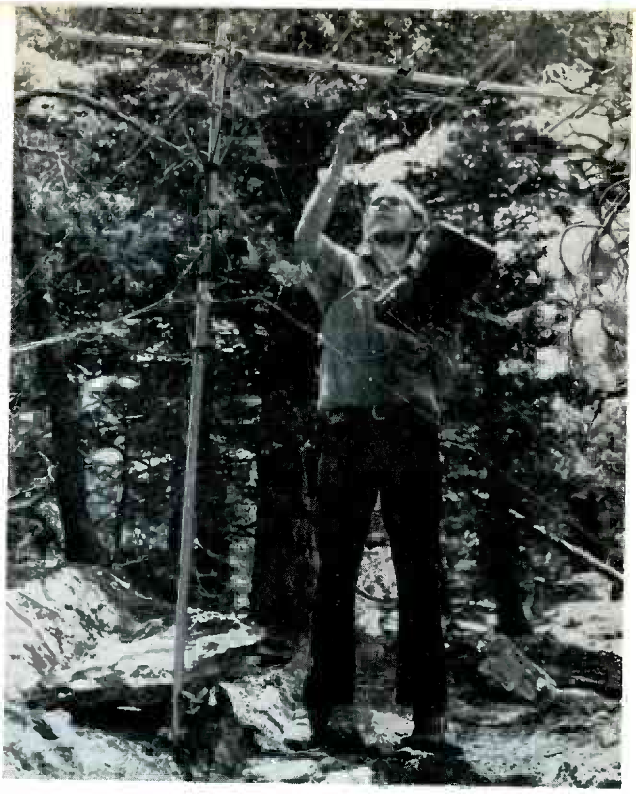


WINEGARD COMPANY
3000 Kirkwood • Burlington, Iowa 52601

For More Details Circle (7) on Reply Card



From top to bottom, the antennas are: two horizontally-stacked high-band yagis for Denver channels 7 and 9; a single low-band yagi for Denver channels 2, 4, 6, and FM; and a single high-band yagi for Colorado Springs channels 11 and 13.



Wayne Benbow, designer and installer of the Greystone MATV system, made signal-level measurements at the remote antenna site to insure adequate signal strength at the TV receivers.

In the mountains, the cable usually is merely laid on the ground, because any cable strung between trees is certain to be ruined by deer, elk, or high winds. Where it crosses driveways or private roads, the cable must "go aerial", or be pulled through culverts. Along steep slopes and over large rocks, the cable needs anchoring or strain relief.

Although a 400-foot length of RG-11/U foam-dielectric cable was mentioned before, other types can be used. Of course, going to a smaller cable with more loss requires added CLA's for a given distance. The line-extender amplifier can compensate only for a shorter length of cable when it has greater loss.

Usually RG-11/U cable (or larger) is recommended as the best compromise between the cost of cable versus the cost of extra CLA's. RG-11/U cable can be run twice as far as RG-59/U, and 43% farther than RG-6/U, before a CLA is required.

A recent addition to the CLA line is a 3-stage VHF-only amplifier which compensates for 1400 feet of RG-11/U foam type cable, or 1000 feet of RG-6/U foam type. This amplifier makes the cheaper RG-6/U cable more attractive, and the VHF-only systems more economical.

Where CLA?

CLA equipment is recommended for any system involving long cable runs, such as in rural, hilly, or mountainous regions. Many Community Antenna Television (CATV) systems are used to bring in signals from metropolitan stations a hundred miles, or more, from small towns. And, whether the antenna is on a high hill or a tall tower, many hundreds of feet of cable are required to reach the community and then distribute the signal to the individual homes.

By contrast, many homes in hilly or mountainous regions are located within the easy range of TV transmitters. However, they might be shielded by a mountain, or in a deep valley where the signals do not penetrate. This type of situation requires an antenna on a mountain top or an unusually high tower. In either case, long cable runs will be necessary, and these require line-extender amplifiers.

The photos on these pages show an actual CLA installation in the mountains of Colorado, west of Denver. The system has 33 hookups and more than 16,000 feet of cable.

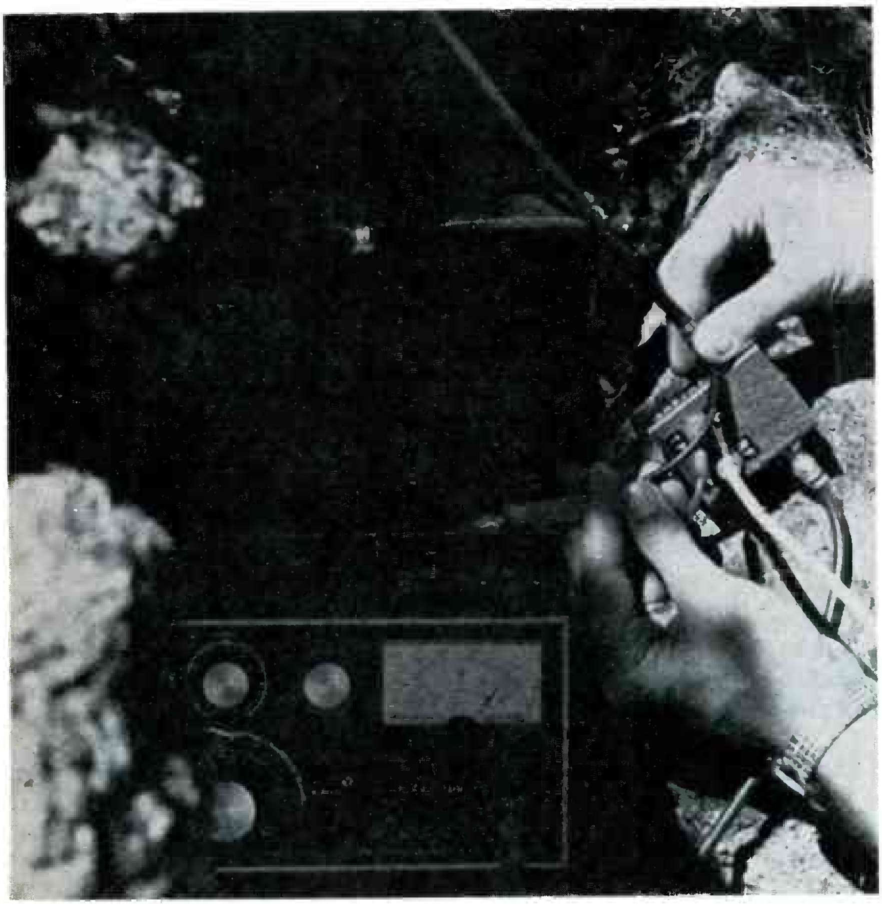
Mobile-home parks also are natural applications for CLA's, because many thousand feet of cable and many tap-offs are needed there.

System Layout

A detailed layout of a MATV

A CLA mounted on a tree provides a convenient test point to check the signal levels. Mr. Benbow is shown connecting a signal-lever meter to the -20-dB test connector.

When the weatherproof cover of the CLA is removed, the level of the output signal can be adjusted by turning the plug-in variable attenuator (upper left). The power transformer at the lower right has taps selected by a switch to compensate for voltage drops in the cable, which carries both power and signals. An internal -12-volt power supply provides regulated DC voltage for the transistors.



A test block permits tapping into the cable to measure signal levels at a -20-dB test jack, and to verify the 24-volts AC by use of a low-voltage neon tester.

The PS-24 power supply needs to be located near a source of 120-volt power. In this installation, it was under the eaves of a house near the foot of the hill where the antenna was mounted. The unit supplies 24 volts AC to power the CLA's and the remote antenna preamplifiers.

Wayne Benbow prepares to make a service call at the home of one of his MATV customers. He offers a 1-year service warranty with each hook-up, and afterwards he charges an annual fee for service and maintenance. This fee includes periodic inspection of the system, plus seasonal adjustments to maintain peak performance.

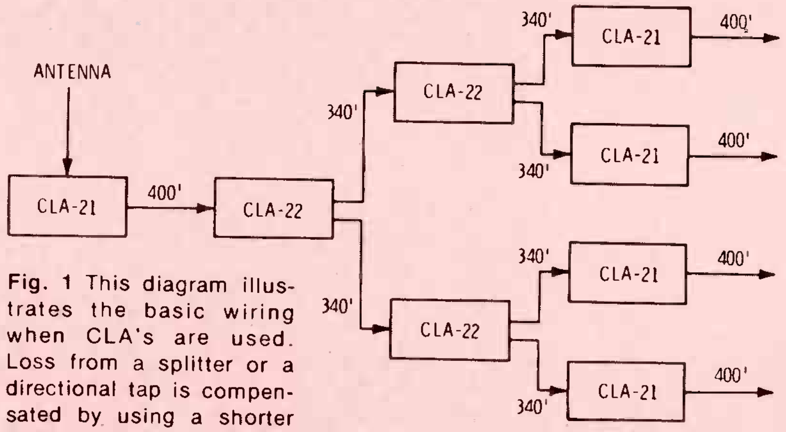


Fig. 1 This diagram illustrates the basic wiring when CLA's are used. Loss from a splitter or a directional tap is compensated by using a shorter cable.

system using CLA's is not absolutely essential, although a rough plan should be sketched out.

The general approach is to start at the antenna (headend), making sure all the channels are equalized for signal level and that none exceeds +46 dBmV per channel. Run 400 feet of RG-11/U foam cable (or 280 feet of RF-6/U foam type), add another CLA, another 400 feet of cable, another CLA, etc. That's all.

When you get near the first locations where the TV signals are to be tapped-off, it's likely you will need a dual-output amplifier, and from it run parallel trunklines with 4-way drops to the individual houses or other buildings.

Splitter losses

Dual-output CLA's have a lower

output level per line than do their single-output counterparts, because of the built-in splitter between the amplifier and the output connectors. Compensate for this loss by using 60 feet less of cable (that is, 340 feet instead of 400 feet) in each of the two output lines that go to the next amplifiers. An example is shown in Figure 1. CLA-21 is a single-output amplifier; CLA-22 has dual outputs.

Direction line-drop taps can be inserted at any point of the cable, and each gives a loss equivalent to 60 feet of RG-11/U foam cable. To compensate for each such tap, shorten the cable between those CLA's by 60 feet.

Mounting CLA's

CLA's and the associated components are completely weatherproofed for outdoor installations. Also, they can be used with buried cable and the CLA's mounted on pedestals; or the CLA's can be installed on aerial pole-lines (messenger-wire type).

Two input connectors are provided, with one at each end of the housing, to simplify the physical routing of the cables for either kind of installation. Pedestal mounting is easier with both input and outputs at one end, while messenger-wire mounting is better when they are at opposite ends.

Power For CLA's

CLA's are powered by an AC voltage between 16 and 24 volts that comes from the same cable used for the signal.

From an out-of-the-weather location that is accessible to 120-volt power, a 24-volt transformer and RF-filter unit furnishes power to the cable. At each CLA, an isolation transformer, rectifier, and series DC regulator produces a regulated -12 volts to power the CLA transistor circuits.

Because the voltage drop across the lengths of cable can be an important factor with long distances, the DC resistance of the coaxial cable selected might be of more concern than the signal attenuation, when you choose the kind of cable. Remember the power path is a loop from the power to the CLA and back to the power source.

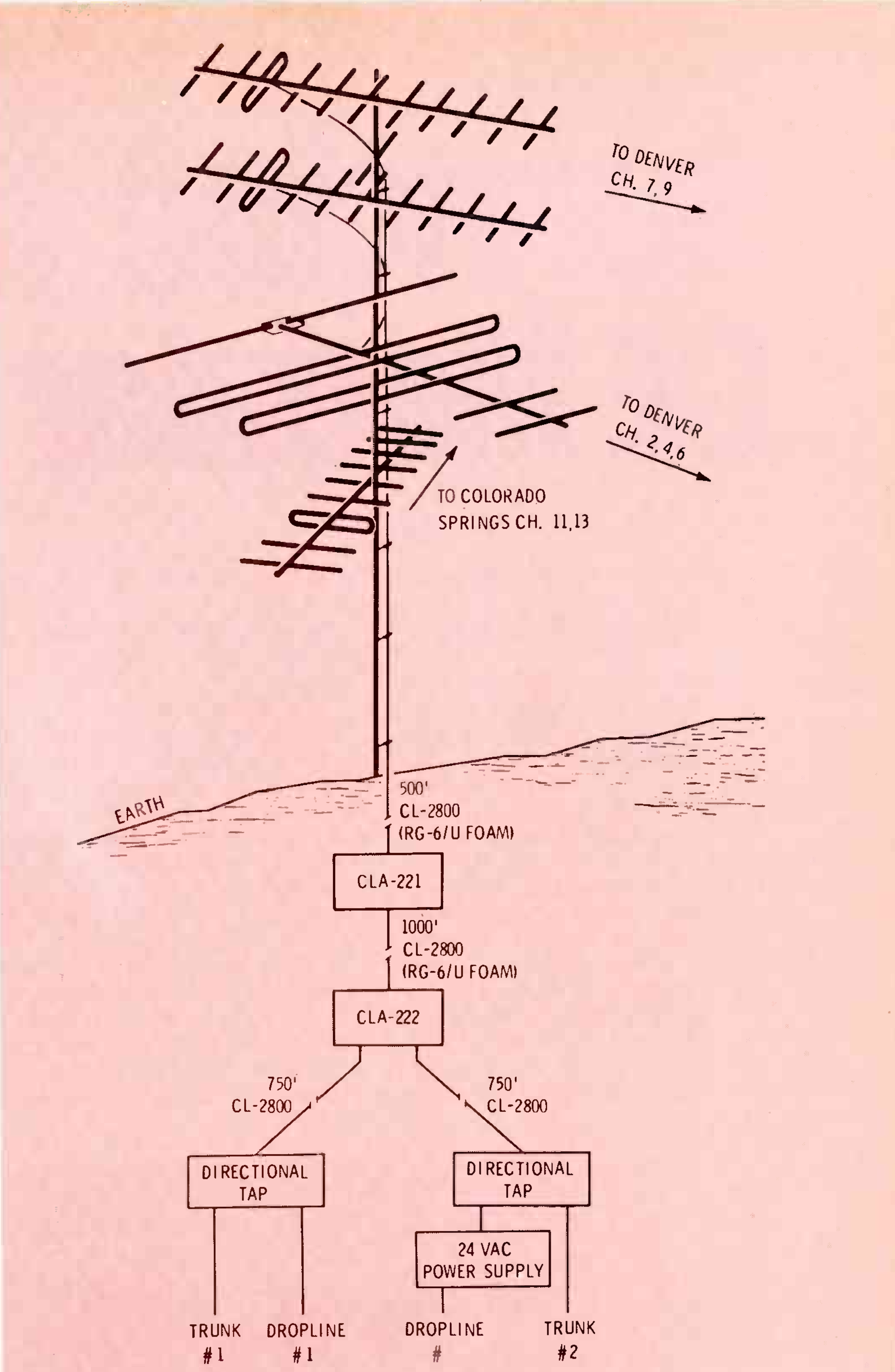


Fig. 2 The Greystone Lazy Acres installation was laid out as shown here.

Comments

Don't let the sheer size of those big MATV jobs scare you. You'll find working with CLA's is much easier than any system you have used before. Examine the actual diagram shown in Figure 2. No tilt compensation is required, and there's no concern about weatherproofing.

One of your most important tools will be a long tape measure! □

Servicing GE Modular Color

Part 3/By Gill Grieshaber, CET

Horizontal sweep, from the noise-cancellation stage to the HV rectifier, of the General Electric 19YC2 chassis is explained.

Individual transistors and other conventional components are employed in the horizontal stages of the General Electric 19YC2 color TV chassis. Therefore, circuit analysis or troubleshooting is easier than in other circuits using IC's.

Sync-separator, noise-inverter, horizontal-oscillator, reactance-control, and monostable-multivibrator stages all are on the EP93X69 plug-in module (see Figure 1). The horizontal-buffer (driver) stage is on the power-supply/buffer module, as explained last month, and the other sweep components are arranged around the right side of the chassis (as you face the rear of the machine).

We will analyze the functions of each basic circuit.

Noise Inversion

Positive-going video enters the oscillator module at terminal PG8-5, as shown in the schematic of Figure 2. R508 serves as a decoupling element, separating the video with noise from the same video after the noise has been cancelled by out-of-phase noise at the output of R508.

Q510 is not supplied with any DC bias from the power supply, so it does not amplify except when noise pulses extracted from the video at the input of R508 reach the base, and act as forward bias. During the time of each noise pulse, the transistor amplifies, producing an inverted noise pulse at the collector of Q510, where it cancels the original noise pulse in the video that comes through R508.

Separating the noise pulses

First, the circuit must accept any noise pulses that have a higher amplitude than the sync tips, and also reject all other parts of the composite video signal. A simple peak-reading rectifier could have been used, but it would have had limitations. Instead, GE has used one diode (Y504) to pass the noise, and another (Y506) to supply a DC voltage that varies in step with changes of the video level, to insure that Y504 cannot pass anything

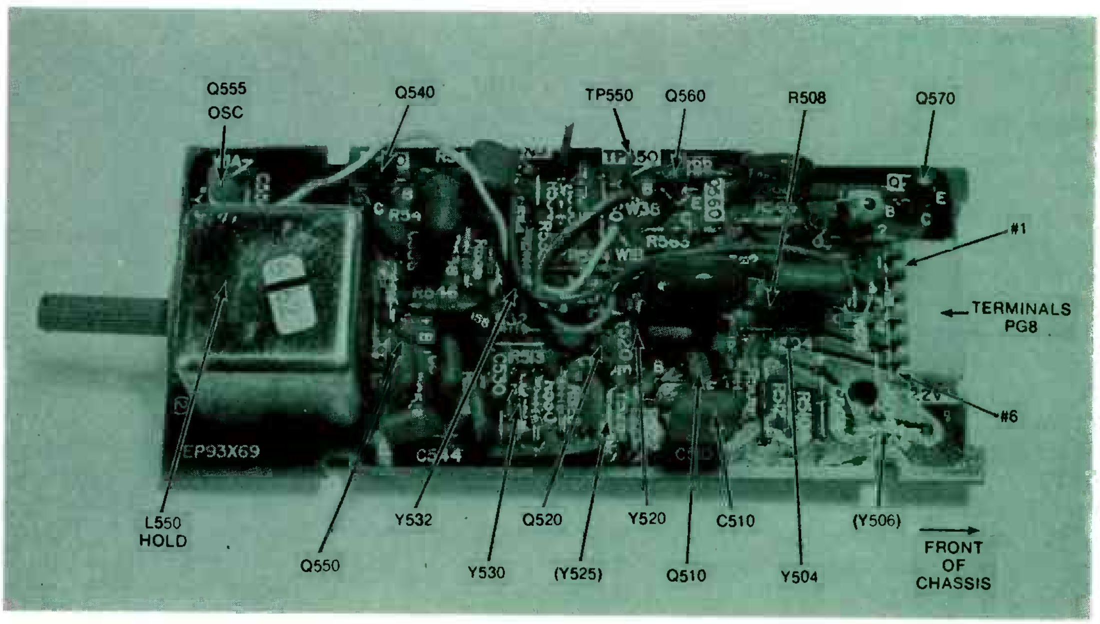


Fig. 1 Arrows point out many of the major components on the horizontal-oscillator module of the General Electric 19YC2 chassis.

Announcing an . . .

Exclusive New Broadband MATV Amplifier

with Automatic Overload Control

Model 3662

Just set it... and forget it.

- Automatic control for input variations of up to 20 dB
- Eliminates nuisance service calls
- 45 dB Gain, VHF High Band
- +52 dBmV Output Capability
- Separate Lo and Hi VHF band controls
- Operates at full output rating
- Switch selectable AOC or MAN operation
- Lightning protected
- Universal rack or surface mounting bracket
- UL listed

Jerrold Model 3662 is the only broadband MATV amplifier with output signal levels automatically controlled. This exclusive feature permits use of the full output capability of a broadband amplifier without fear of overload due to input signal fluctuations. AOC operates to:

1. Prevent overloading the amplifier when input levels increase.
2. Increase amplifier gain to compensate for signal fades.
3. Prevent system cross-modulation even if only one channel level increases or fades.

TRY THE 3662 FOR YOUR NEXT MATV INSTALLATION

JERROLD ELECTRONICS
GENERAL INSTRUMENT CORPORATION
Horsham, Pa. 19044 • (215) 674-4800

For More Details Circle (9) on Reply Card

except a part of the sync tips and strong noise pulses.

Y504 operates as a series rectifier of the proper polarity to pass the positive peaks of any signal at the anode. Then, to make certain that Y504 passes only the most-positive parts of the waveform, a filtered reverse-bias voltage (obtained from rectification by Y506 of the same video) is applied to the cathode of Y504. **This DC voltage rises and falls as necessary to limit the conduction of Y504 to only the sync tips and the noise pulses.**

The rectification by Y506 is made to be peak-reading by C504, and this also minimizes the ripple at the output. Then R510 and R506 bring the positive voltage to the cathode of Y504. A DC voltmeter paralleled across Y504 shows it has about one volt of **reversed** bias. Of course, a diode cannot conduct until the anode is more positive than the cathode, so it would seem that Y504 is permanently cut-off. But this one volt is an **average** voltage, which permits the positive tips of the video to make the anode positive relative to the cathode.

The waveforms of Figure 3A show 4.5 volts PP of video at the anode of Y504, and 1.4 volts PP of sync tips at the cathode. The average reverse bias has prevented any diode conduction except during the sync tips (or during any noise having a higher amplitude).

If the full 1.4 volts of sync tips were allowed to reach the base of Q510 without being modified, the amplitude would be sufficient to forward bias the base and produce amplification of the sync tips. But the waveform is differentiated by C510 and R514, as shown in Figure 3B. When the zero-voltage line is

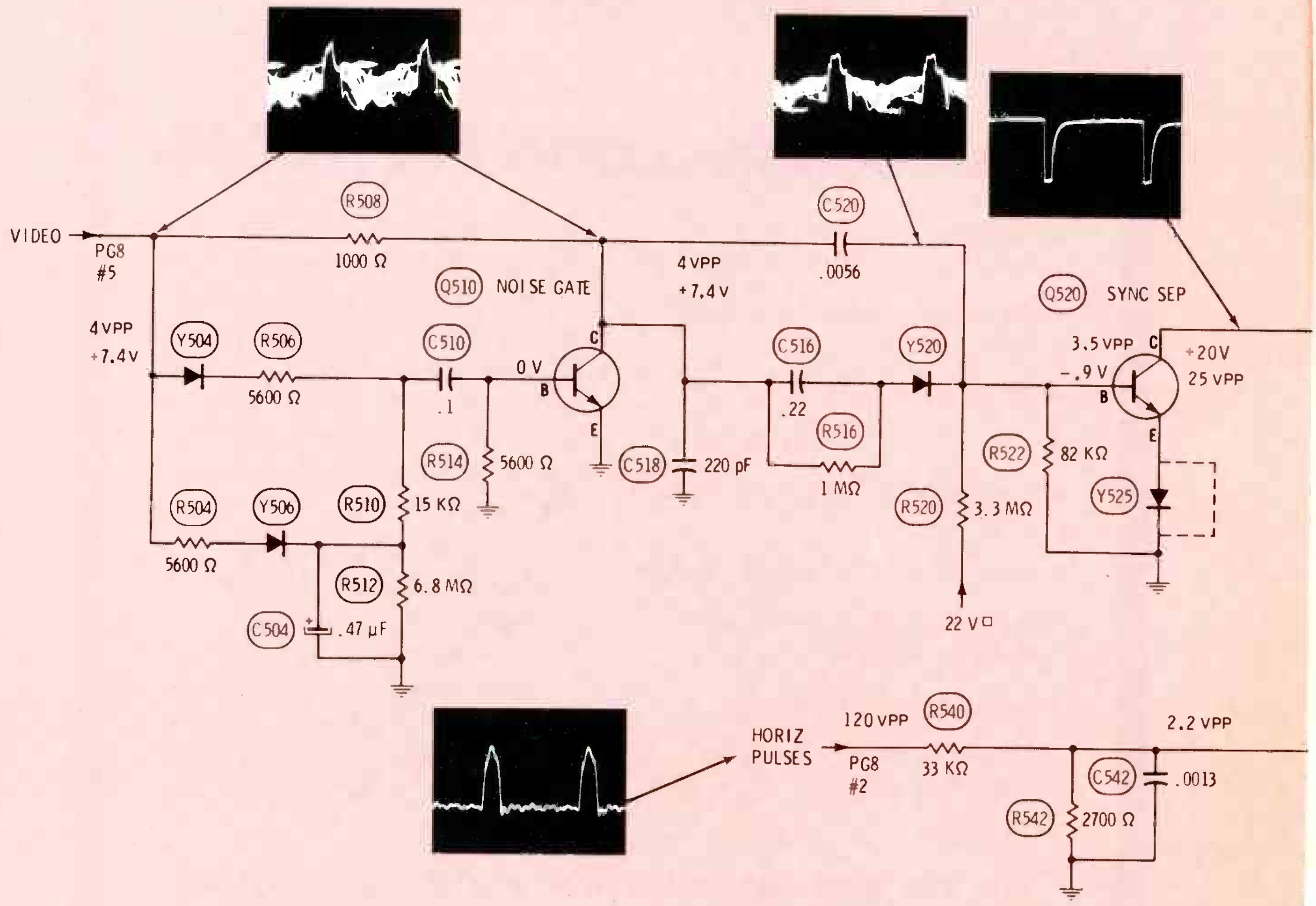


Fig. 2 Here is the schematic of the noise-cancellation, sync-separator, and phase-detector circuits, with voltages and waveforms.

added by the second trace of the scope, we find that the positive pulses (all that remains of the sync tips) have an amplitude of only +0.2 volt peak, and that's not enough to cause conduction of Q510. Therefore, **when the video signal does not have any serious noise pulses, Q510 does absolutely nothing.**

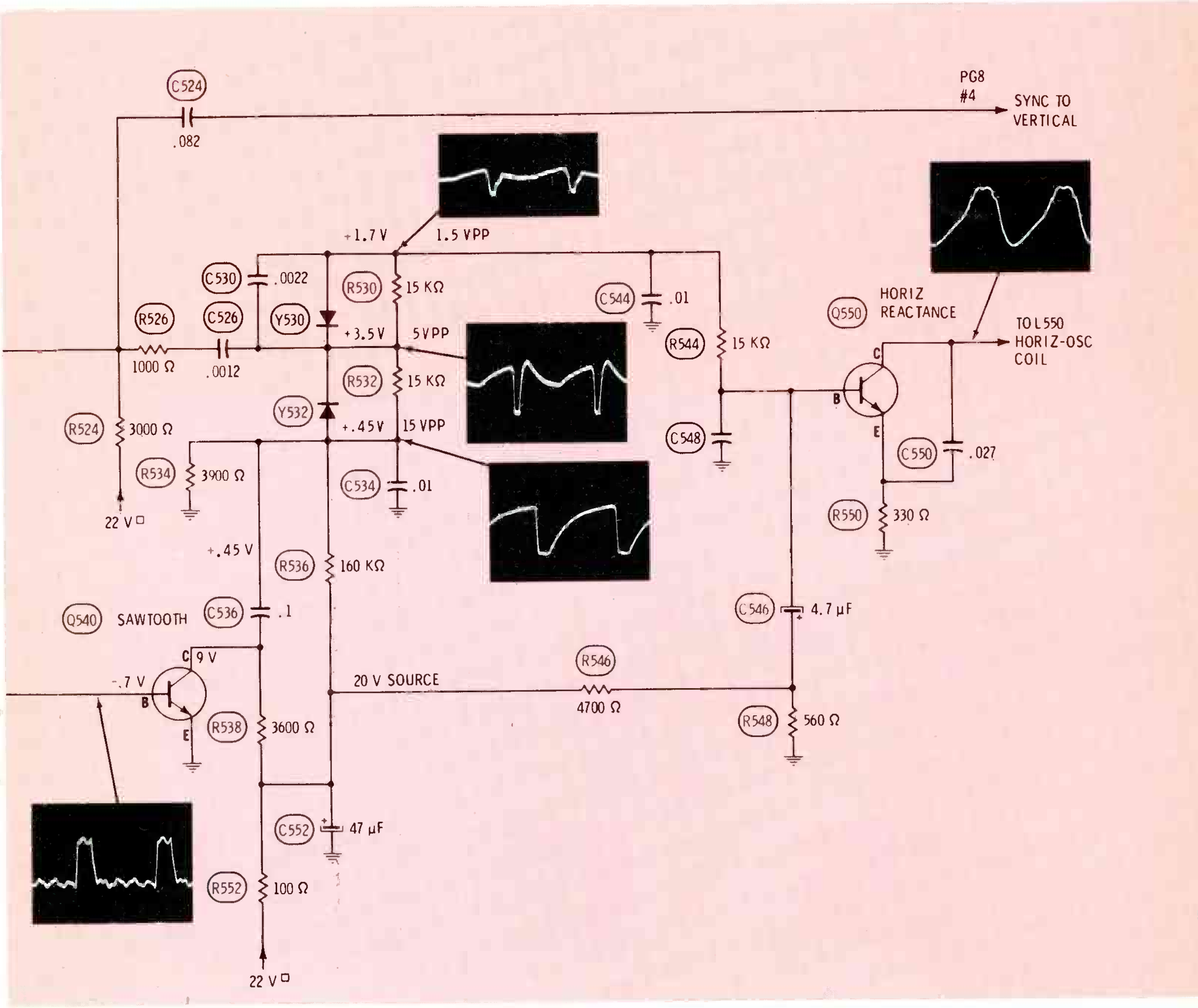
The time constant of the Y506 circuit is quite long (.47 microfarads and 6.8 megohms), so it can't change voltage fast enough to follow any narrow noise pulses. Now, the reverse voltage applied to the cathode of Y504 follows only the average amplitude of the sync tips. So, when a noise pulse arrives, the DC level at the cathode of Y504 doesn't change; instead the full amplitude of the noise pulse goes through Y504, and eventually to the base of Q510. This biases Q510 into conduction and gain, producing a noise pulse of opposite polarity that cancels the original noise pulse in the video that has come through R508.

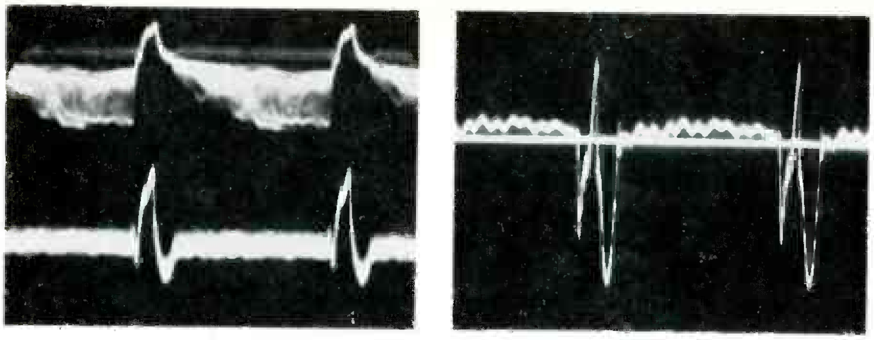
Does the circuit actually cancel the noise, and can it be proved? Yes, the noise certainly is eliminated from the video supplied to the sync separator (but not the video going to the picture tube, where the noise still appears as black dots or lines). Refer to the waveforms of Figure 4.

The Sync Separator

Sync separation in the Q520 stage is conventional. A dual time constant is used at the base. Horizontal-sync pulses go through C520 to reach the base, while the wider vertical sync pulses go through C510 and Y520 diode.

When there is no video at the





A B

Fig. 3 These are waveforms of the late-production noise-cancellation circuit (the one without Y506). Photo (A) top trace is the video signal at the anode of Y504; bottom trace shows the sync tips at the cathode of Y504 (they're all that's left of the video after clipping). Photo (B) has the zero-voltage line added to the differentiated sync waveform at the base of Q510. Overshoot from the high-pass filter action of C510 and R514 moves the zero line up, so the positive tip does not have enough amplitude to bias-on the base of Q510. Therefore, Q510 does not amplify, unless there are stronger noise pulses there.

base. R520 and R522 supply about +0.6 volt to the base for forward bias. Of course, when video is supplied to the base, the base/emitter junction rectifies it, producing an **average** negative base voltage (as measured by a DC meter). Incidentally, diode Y525 was not in the emitter circuit of the sample module I checked.

Sync, to be integrated for locking the vertical, exits through C524, and the horizontal sync goes through R526 and C526 to the common cathodes of the phase-comparison diodes, Y530 and Y532.

This kind of phase-comparison circuit requires a sawtooth of horizontal sweep at the low end, and the control voltage for the reactance transistor is taken from the top, filtered, and fed to the base of Q550. R536 and R534 supply the forward bias for Q550, with the correction voltage from the diodes between that point and the base.

Horizontal sawtooth

Most of the new solid-state sets produce a sawtooth waveform for the phase diodes by integrating the output of a transistor amplifier, rather than by direct filtering of horizontal-sweep pulses. So it is in this circuit.

Horizontal pulses enter at terminal PG8-2. They are filtered and the amplitude reduced by R540, R542, and C542 before the signal is applied to the base of Q540, the sawtooth shaper. No forward base bias is supplied, but the input signal furnishes AC bias. C536 couples the collector signal to the diodes, and C534 changes the pulses into sawteeth.

As the phase of the horizontal sawteeth versus the sync pulses changes, rectification by the phase-detector diodes produces a DC voltage that might be negative, positive, or zero. This control voltage changes the fixed bias that's available from R536 and R534, and varies the forward bias of Q550, the horizontal-reactance transistor. Pic-

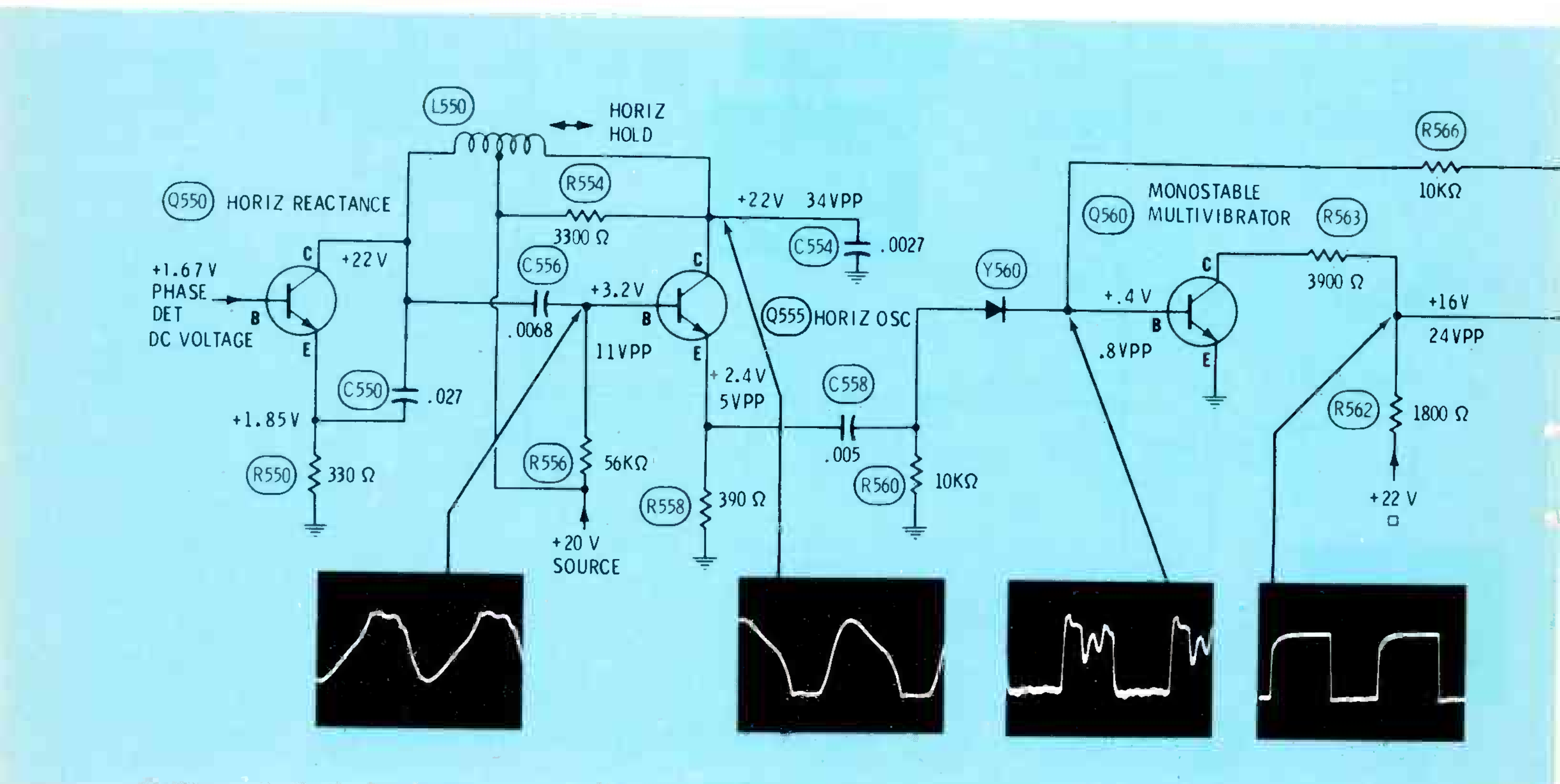


Fig. 5 This schematic of the horizontal-oscillator, monostable-multivibrator, and buffer circuits also shows the waveforms and voltages.

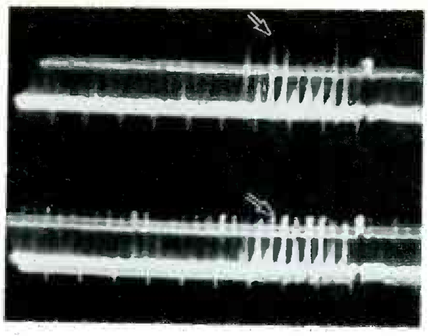


Fig. 4 The top trace shows the video from a color-bar generator at the input of R508, when strong impulse noise pulses are present. The bottom dual-trace waveform is the same signal at the other end of R508 after the noise pulses have been cancelled.

ture bending and "pie-crusting" is prevented by C544 and R544/C546/R548.

Horizontal reactance

Tuning of the horizontal-oscillator coil is by two capacitors: C554, from the collector of Q555 oscillator to ground; and C550, which is wired from the base end of the oscillator coil to the emitter resistor (R550) of the reactance transistor, Q550 (see Figure 5).

Also, the C/E junction of Q550 is paralleled across C550. When the base bias of Q550 is changed by the phase detector, the C/E resistance of Q555 changes, and this affects the tuning of the oscillator coil.

Incidentally, the horizontal oscillator appears to have low drift and solid locking, because during weeks of testing it was not necessary to reset the frequency. The core of the oscillator coil is adjustable by a plastic shaft (Figure 6) that's available from the rear of the machine; there is no front panel horizontal control.

Horizontal Oscillator

Superficially, the oscillator resembles a Hartley type. However, the tuning capacitors are wired differently, and the tap of the coil is not in the center. Perhaps the most significant change is the unbypassed emitter resistor; and the degenerative signal there is used as the output to drive the monostable multivibrator.

Monostable multivibrator

I can only guess that a stage was needed to shape the waveform coming from the oscillator before it was suitable as an input signal for the driver transistor. In any event, the monostable multivibrator (using Q560 and Q570) does that job.

If a capacitor were added in series with R566, between the collector of Q570 and the base of Q560, the circuit would be a conventional AC-coupled multivibrator, which would oscillate whether or not a synchronizing signal came from the oscillator. But the capacitor is **not** there, so the monostable multivibrator does not oscillate. Instead, it switches "state" with every output from the oscillator. Therefore, the signal from the oscillator through Y560 diode to the base of Q560 is **not** a synchronizing signal (for an oscillator), but it is a **drive** signal. The dual-trace waveforms of Figure 7 prove the monostable stage is not a divider; input and output signals have the same repetition rate.

Horizontal Buffer

As shown in the diagram of Figure 5, the horizontal-buffer (driver) transistor and the associated components (including the T910 driver transformer which feeds the output transistor) are mounted on the power-supply/buffer module. Perhaps because of the long length of wires across the chassis, the base

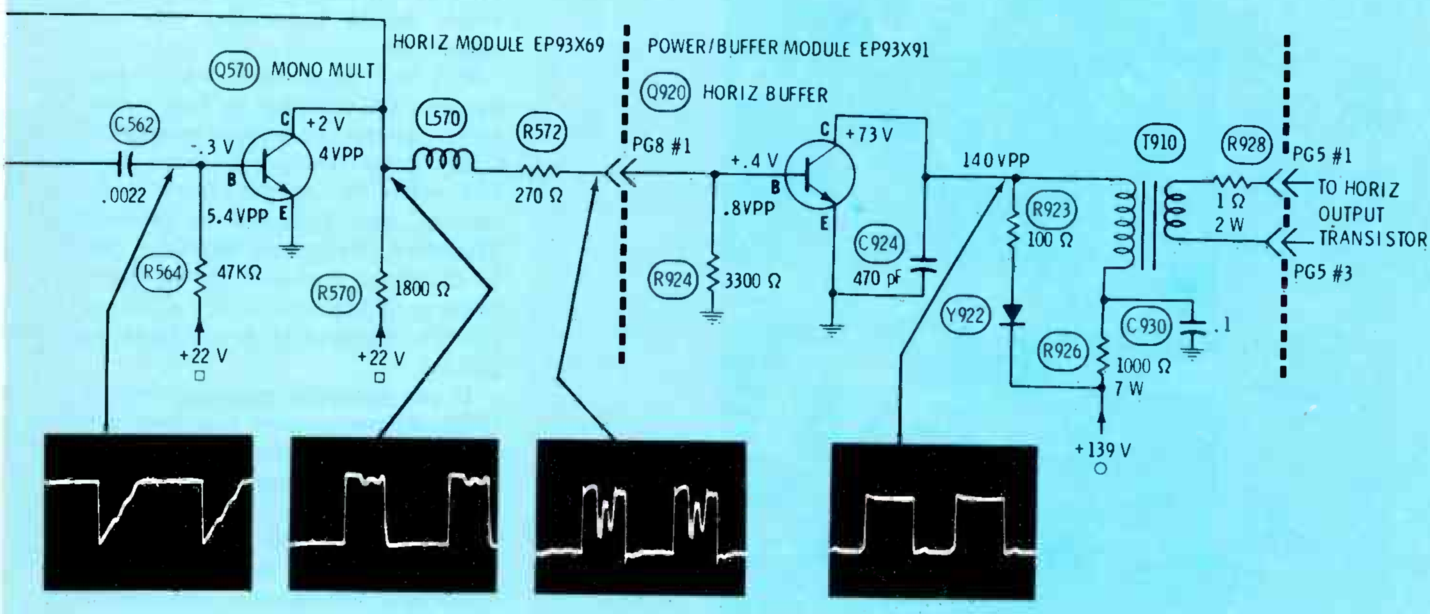


Fig. 6 Horizontal frequency (locking) is adjusted by the core of the oscillator coil; it is the only adjustment on the horizontal module.

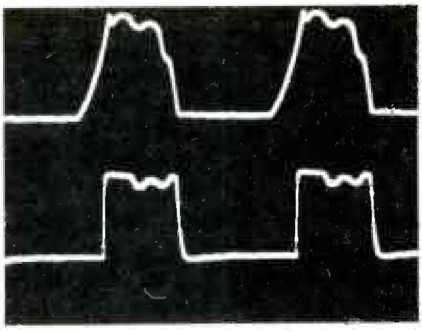


Fig. 7 These dual-trace waveforms prove that the monostable multivibrator does not divide the frequency. Top trace is the emitter of the oscillator, and the bottom waveform is found at the collector of Q570.

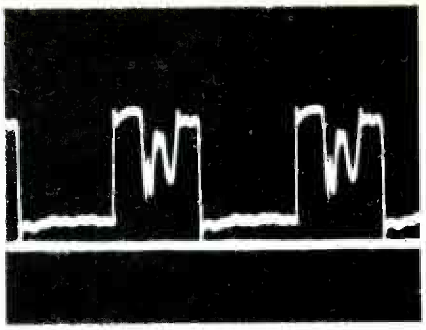


Fig. 8 The base signal of Q920 buffer transistor shows some inverted flyback pulses, probably because of capacitive pickup in the wiring. The zero-voltage line proves that most of the DC voltage there (as measured by a meter) is merely the average of the square wave amplitude, because they are clamped to ground near the negative peak.

waveform of Q920, buffer, has some negative-going high-voltage pulses added to the square waveform (Figure 8). There is only a trace in the collector waveform, so the added glitch apparently doesn't bother the operation.

Figure 8 has the zero-voltage line added, and it shows that the bottom of the square waves is nearly at zero. A DC meter reads the **average** waveform here, because the bottom is approximately clamped to zero. Keep this in mind, when you measure peak-to-peak and average DC of signals with pulses.

Horizontal Output

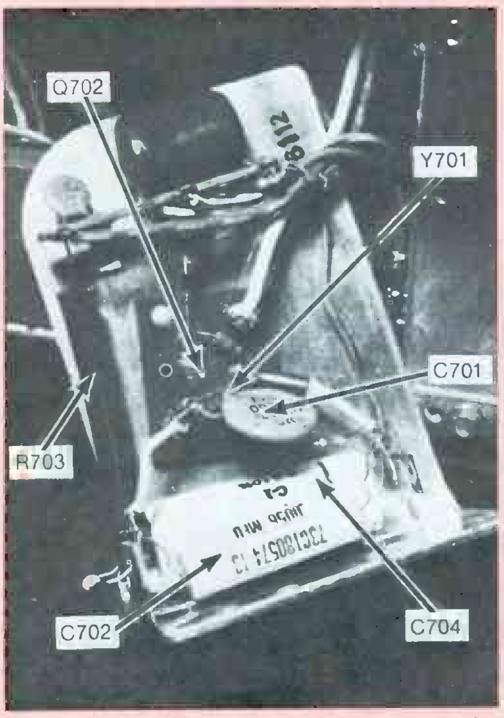
The horizontal-output stage is almost conventional, except for the emitter of Q702, the output transistor, which is not grounded, but goes to a winding of the flyback transformer, T710 (Figure 9).

Now, placing an unbypassed-load in an emitter circuit usually causes loss of gain because of degenerative-type negative feedback. Such a loss of gain does **not** occur here, because the base return (secondary of T910) is not to ground, but back to the emitter of Q702. Therefore, any voltage developed from emitter to ground does not affect the drive to the base. Signal voltage (of opposite polarity) can be developed in the emitter circuit the same as at the collector. The amount of voltage depends on the impedance. This is an important principle, which should be studied and remembered.

Use extreme care when you measure DC voltages, or take waveforms around the output transistor, Q702. Pulse voltages of more than 440 volts PP appear from base, emitter, and collector to ground. Therefore, the output transistor can be destroyed instantly by an intermittent connection or a short circuit, especially from base to ground.

If you measure anything around Q702, we recommend that you turn off the power, connect to the circuit by using an insulated-hook type of probe, and turn on the power for the test. Then turn off the power, before you remove the test probe.

Because the collector and emitter pulses (to ground) are many times stronger than the base/emitter drive of Q702, both the base and emitter appear to have the same waveform,



Several components are mounted behind the bracket that holds the socket for the horizontal-output transistor.

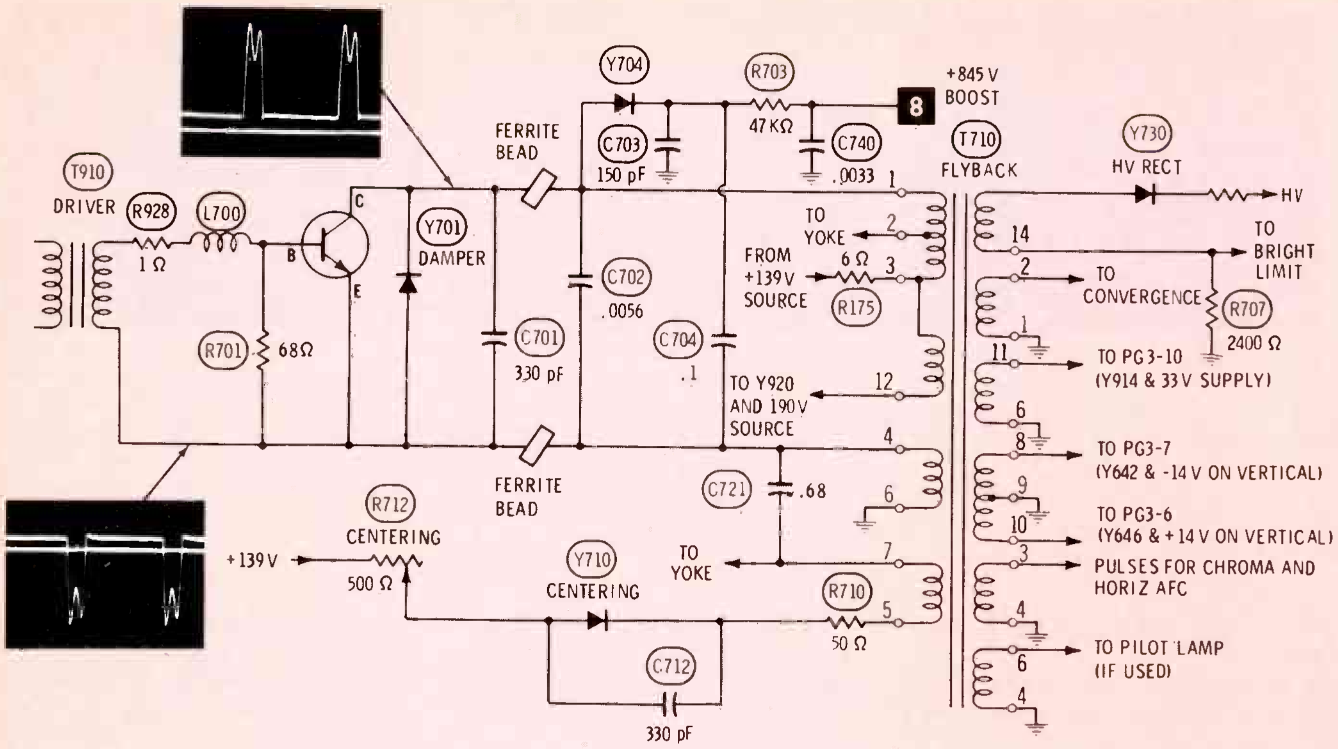


Fig. 9 The schematic shows that the emitter of Q702 does not go to ground, as is customary, but goes to a winding of the flyback. Zero-voltage lines on the waveforms indicate a positive supply DC voltage mixed with the collector signal, while the emitter waveform has virtually no DC. Horizontal centering is accomplished by DC yoke current from diode Y710. Capacitor C702 has a major effect on the amount of high voltage; if it opens, the HV will be excessive. Many of the flyback pulses go to the power-supply/buffer module for distribution.

when they are measured to ground.

It is possible, if your scope is insulated from the AC line and all other grounds, to float the scope between base and emitter. The waveform (Figure 10) is similar to that in many other horizontal-output circuits.

Incidentally, it is very difficult to obtain reliable DC readings in the presence of strong pulses. Simple VOM's usually are not sensitive enough; and VTVM's, FET meters, and digital multimeters tend to overload from the overpowering pulses. This causes self-rectification, and produces wrong readings. For example, a digital multimeter, with only the ground lead connected to the emitter of Q702, just went wild and gave all kinds of erratic and wrong readouts. It was operated on internal batteries, without any AC cable, so the problem was not connected to leakage to 120 volts. Apparently, the stray capacitances of meter or leads were responsible. An old VTVM measured the base as +0.7 volt from the emitter, but a scope waveform (with the zero-voltage line added) indicated that the reading should have been negative (Figure 11).

I have never heard why the base waveform of a horizontal-output transistor in a circuit like this one should have so many extra pulses and ringing lines. My guess is that they are produced by capacitance feedthrough **inside the transistor.** Figure 12 shows that the base-emitter waveform is changed to near-square waves, when the output transistor is removed from its socket.

Some writers have said that horizontal-output transistors act only as on/off switches. The implication is that the collector current would be in square waves. **That is wrong,** and the proof is in Figure 13. The top trace shows the collector current of Q702; center trace is a sample of flyback voltage pulses which show the phase of the currents; and the trace at bottom is the current of the damper diode, Y701. Notice that the transistor current flows for a longer period of time than the damper current does. Try to reconcile these legitimate current waveforms with some of the un-proven theories of transistorized horizontal deflection!

Pulse Waveforms

Notice the double tips of the flyback pulses. The two tips are formed by ringing at the third harmonic of the 15,734-Hz sweep, and the ringing is produced by the total inductances and capacitances of the horizontal-sweep circuit.

At the collector and emitter of the output transistor, these two tips are very distinct. However, from other taps of the flyback (such as those whose waveforms are shown in Figure 14), the tips are blurred, as though having bursts of RF on them.

When one pulse was expanded by the triggered scope, the blur (Figure 15) could be seen as ringing which moved sideways. Apparently this comes from the pincushioning circuit, and is normal for the model.

Troubleshooting

General Electric recommends three alternate methods of servicing problems that are located on modules; they are:

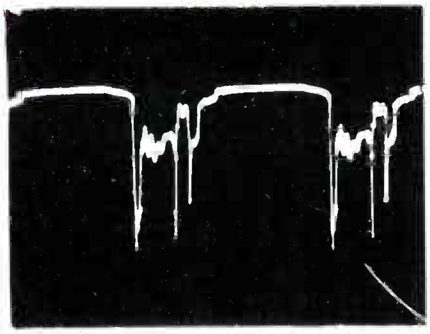


Fig. 10 A scope floated between base and emitter showed this 12-volt PP waveform at Q702, the horizontal-output transistor.

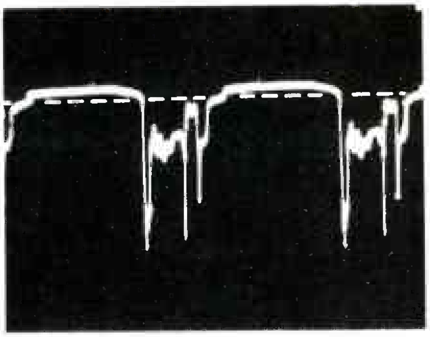


Fig. 11 A zero-voltage line added to the previous waveform indicates the base *should* measure slightly negative relative to the emitter of Q702. But when a DC meter is used, the high pulse voltages at the emitter make this measurement very unreliable.

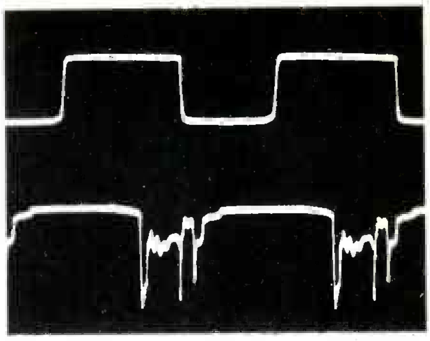


Fig. 12 Top trace illustrates the conventional square waves found at B/E of Q702 when the transistor is removed from its socket. The bottom trace is the normal one, included for comparison.

- Install a new replacement module;
- Substitute a new module long enough to locate the defect, then repair the bad module and reinstall it; or
- Repair the defect, using conventional methods, without being concerned about whether the defect is on a module or not.

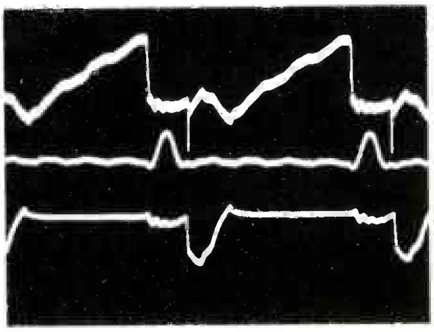


Fig. 13 Waveforms of the current in deflection circuits should be published more often; we can learn much about circuit operation by studying them. Top trace is the collector current waveform of the horizontal-output transistor. The HV pulses are shown by the center trace to establish the phase relationships; and the damper-diode current is shown by the bottom trace.

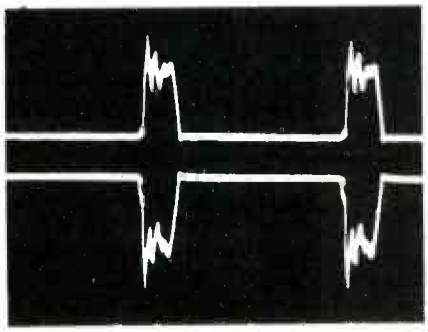


Fig. 14 Top trace shows the 135-volt pulses at terminal 8 of the flyback; while the bottom trace pictures the 140-volt pulses at terminal 10. These waveforms, with ringing on the tips, are typical of those coming from the flyback.

Most of the wiring of this model either is accessible, or can be made so by removal of a module, or loosening a bracket.

Late-production horizontal-oscillator modules have a few circuit changes. In Figure 2, R504, Y506, C504, and R510 are eliminated, and R512 is changed to one megohm.

A shorted Y504 diode, in the late version, causes critical vertical locking, and intermittent picture pulling (output of the sync separator is shown in Figure 16). Of course, an open diode or open Q510 has no effect, unless there is noise. In that case, the noise cancellation does not operate. A Q510 transistor with a C/E short (the most common kind) would eliminate all sync, and the horizontal would be far out of lock.

Many of the pulses from windings of the flyback go first to the power-supply/buffer module, and are distributed to the various circuits from there by the connectors and cables.

High voltage of this individual receiver measured 28 KV at 120 volts of line power, when the screen was black. This decreased to only about 27 KV at normal brightness level.

The high-voltage rectifier unit plugs in, so removal for testing or replacement is very easy.

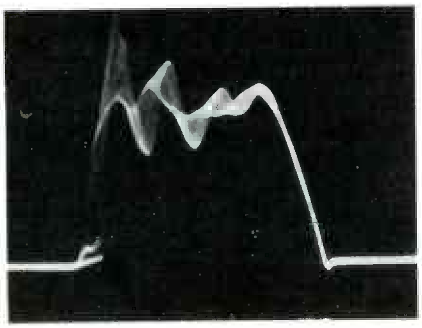


Fig. 15 When one flyback pulse was widened by the scope, it was plain that the ringing moved sideways in a regular pattern (probably from the pincushion action).

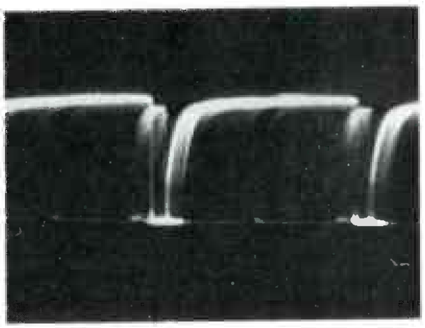


Fig. 16 If Y504 shorts (in the noise cancellation circuit), the output of the sync separator is contaminated with video (as shown), and the picture pulls and rolls intermittently.

Next Month

Vertical-sweep circuits and the scan-rectified power supplies on the vertical module are the subjects of our examination next month. □

How To Calculate Your Hourly Rate

By Dick Glass, CET

The following article is reprinted by permission of Howard W. Sams & Co., from "Service Shop Management Guide", book number 21346.

Most shops seem to feel that it is nearly impossible to closely estimate the hourly rate they need to make a reasonable profit and to pay wages and overhead. They say that there seems to be too many variables: the amount of service work seems to vary; the tough dogs require so much extra time; and the flat-rating of service calls, over-the-counter jobs, and benchwork makes an hourly rate of little value.

These things all seem to be true. However, the flat-rate charges have to be based on actual average time spent. For instance, the charge for a TV bench repair should be about three times the charge for a service call because it takes about three times as long to do the average bench repair.

Tough dogs are a permanent part of your business

As long as you are in the servicing business, you will have tough dogs. Every one of the 190,000 American service technicians regularly runs into tough dogs, so it follows that tough dogs are not your fault and you should not feel that you must pay a personal penalty in time and dollars for them. You should estimate your tough dog expense and consider it the same as any other legitimate expense, as a cost to be included in your hourly rate.

The fact that there are so many variables in the servicing business is only one more reason why you should know your exact cost of doing business and know exactly what your hourly rate must be. If your rates are based only on how fast you think you can repair a set and you do not consider your lost time (billing time, parts procurement time, management time, and so on), you are like a landlord who rents out a house only six months out of the year, yet who bases his rent charge on its being occupied all 12 months of the year. The house eventually will fall into disrepair because the landlord can't afford to repair it, and since he is losing money, he has no incentive to repair it.

Some more reasons for knowing your hourly cost of doing business are:

1. Once you know your rate per hour, you can better estimate special jobs for which you have no established flat rate.

2. Many shops find that their service-call price matches their hourly rate. (Time studies show that an average service call involves about one hour of time.)

3. Pricing systems, such as the Sperry Tech *TV & Radio Tech's Guide to Pricing,* are workable only if you know your hourly rate.

4. Warranty work can be analyzed better if you know your cost.

5. Knowing your cost—not guessing—can give you the facts you need to counter customers' complaints regarding your prices. (You need the conviction that your prices are fair.)

6. Should you ever be the target of a "TV fraud *expose*" by consumer agencies or communications media people, you can easily defend yourself if you know your cost (especially if you also are acquainted with industry averages).

Two methods of establishing rates are discussed in this book. They are the Nesvik System and the Sterling System.

The Nesvik System for calculating rates

Using the Nesvik System, we will analyze the costs that a typical one-man TV service shop might have and the profit and return on investment that it needs. By adding all of the costs shown in Chart 8-1, we can establish an hourly rate.

Based on an hourly rate of $15.80 and a 40-hour work week, the technician owner must have $632 per week (see Chart 8-1). Since he cannot charge for all of the 40 hours that he works each week, he must divide the $632 needed each week by the number of hours he will actually be doing service work. Let's assume that he will work 25 hours per week (actual time spent on service work). To

	Per Hour	Per Week
Technician Wage	$7.00	
Overhead Costs ($8000 ÷ 2000 hours)	$4.00	
Profit of 30% on Overhead and Wages ($11.00)	$3.30	
15% Return on Investment ($20,000)	$1.50	
Total	$15.80	
40 Hours Per Week		$632.00

Chart 8-1. Using the Nesvik System for a One-Man Television Service Shop

Shop B's Wages (40 hours per week)	$14,000
Business Profit (10% of last year's sales)	$5,000
Return on Investment (15% of $18,000)	$2,700
Total (desired income)	$21,700
Last Year's Net Income	$15,000
Insufficient Income	$6,700

Chart 8-2. Shop B's Income at $7.00 per Hour

determine his hourly rate, simply divide $632 by 25 hours and you get $25.28 per hour.

If the technician owner were able to charge for an average of only 20 hours per week, or 50% of his 40 hours, then his rate would have to be $31.60 per hour (see Chart 8-1).

If this typical technician calculated his rates as we have in Chart 8-1, he would need $25.28 per hour and would have to be productive 62½% of the time. If he is performing service on warranty or contract repairs, where no parts profits are realized, he must have the $25.28-per-hour rate. On repair work where parts are sold, he can use his parts profits to decrease his rates. For instance, if he had $25,000 labor income and $15,000 parts sales (at 100% markup), this would give him $32,500 gross profit. He could then charge $6.00 less per hour and still make $632.00 per week. His hourly rate then would be $19.28.

The Sterling System for calculating rates

In Chapter 5, shop B was shown to have made a $5000 annual net profit. This $5000 is in addition to the owner's share of wages of $10,000, for a total taxable income of $15,000. The owner felt he had to be open for business 60 hours a week. If you multiply 60 hours by 50 weeks, you get 3000 hours. Divide $15,000 by 3000 hours and you get $5.00 per hour.

Owner B said to himself, "Well, $5.00 per hour isn't too bad." But his accountant pointed out to him that the business must have a profit in order to survive and that owner B is also entitled to some return on his "risk capital."

His $18,000 capital investment (cash, tubes, test equipment, truck, etc.) could have drawn 7½% in a bank, or $1350. But, since an electronics repair business is considered far more "risky" than the bank for an investment, most service technicians consider a 15% return on their high risk capital more realistic. To figure owner B's return on his high risk capital, multiply .15 by $18,000 and you get $2700 per year.

In addition to a fair return on invested capital, the shop should make a profit. In fact, it has to make a profit to expand, to improve its ability to perform service, and to keep going in slow periods.

What might be considered a fair profit? You have to be the judge in your business. A Small Business Administration book entitled *A Handbook of Small Business Finance* states that "a primary purpose for owning and operating your own business is to make the highest possible profit for yourself." So, you be the judge of the amount of profit your business should strive for, after giving yourself a reasonable return on your investment and after paying yourself for your own physical labor at the prevailing rate in your area. Let us use 10% profit in this illustration. For shop B, which has $50,000 worth of parts and labor sales, that would be $5000. Therefore, the owner of shop B should analyze the $15,000 he paid taxes on and deduct $2700 for return on investment and $5000 for the profit that the business needs. To find shop B's real wages, subtract $7700 from $15,000 and you get $7300. To find shop B's hourly wage, divide $7300 by 300 hours and you get $2.43.

What should the owner of shop B set as a goal for himself? Obviously, $2.43 per hour is not sufficient.

The owner of shop B checked around his town and found that good experienced technicians, like himself, were receiving over $6.00 per hour. With fringe benefits, it was about $7.00 per hour.

He made the decision to pay himself $7.00 per hour, as shown in Chart 8-2.

If we assume that owner B already is receiving "top dollar" for his parts, the only place to make the needed $6700 (insufficient income) is from labor.

Last year, shop B took in $30,000 for labor. If both the owner and the shop technician worked 40 hours per week, or 2000 hours each (4000 hours total), then they earned an average of $7.50 per hour in labor for each hour they worked. Shop B's rates are shown in Chart 8-3.

Since the hourly rate is $15.00 ($7.50 per hour for each), they were 50% productive. We could increase productivity and recover the $6700, but most shops are already as efficient as they can be.

We could increase parts prices by 33½% to recover the additional $6700, but since parts prices are comparable and somewhat competitive, most shops would rather keep them at suggested retail prices.

So, we must increase labor rates to derive an additional $6700. To find out by what percent the $30,000 total labor figure was short,

Hourly Rate	$15.00
Service Call	$15.00
Bench Repair (total)	$45.00

Chart 8-3. Shop B's Old Service Rates

	Old Rate		22% Increase	New Rate
Hourly Rate	$15.00	X	1.22	$18.30
Service Call	$15.00	X	1.22	$18.30
Bench Repair	$45.00	X	1.22	$55.00

Chart 8-4. Shop B's Service Rates Increased by 22%

divide $6700 by $30,000 and you get 22%. Therefore, to bring the labor income up $6700, multiply the old rates by 1.22 as shown in Chart 8-4.

Inflation factor

If the owner in shop B neglects to anticipate the expected 8 to 10%

inflation rise each year, he will find himself behind in wages each year. He will never catch up. Therefore, to keep his rates up to date, he needs to consider an inflation factor. We will use 10% in the example shown in Chart 8-5.

The calculation of shop B's rates (Chart 8-5) has one flaw in it. The owner of shop B did not work 40 hours per week (2000 hours annually); he really worked 60 hours per week (3000 hours annually)! If he intends to continue working 60 hours and intends to earn $7.00 per hour for himself for each of those hours, then his wages are not $6700 short, but an additional $7000 short, or $13,700 total. To increase his wages by $13,700, he needs to increase his rates by 45%, plus the inflation factor (Chart 8-6).

Assuming that owner B expects to start working a regular 40-hour week, he must complete in 40 hours the amount of work he did last year in 60 hours, or increase his prices to the $23.93 rate for the hours he and his technician do charge.

The only other way to maintain lower labor rates is to increase productivity (which he will have to do to decrease his hours from 60 to 40) or manage to increase his parts sales and profits.

Some repair shops increase their parts profit by charging "installed prices" for parts used on home calls and bench jobs. Other repair shops increase their small parts profits by charging a "stocking charge" to cover the handling and inventory costs on small items such as resistors, capacitors, etc. Some repair shops routinely check all tubes in the set and attempt to sell all tubes that check weak with each repair. I believe that many shops are losing part of their potential profit by not checking all tubes.

Conclusion

The single biggest problem with consumer electronic service shops today is their lack of the knowledge necessary to set service rates. Technician-owners most often feel that they should become more efficient or productive and that then their competitive rates will be sufficient. They feel that they must work long hours because they are not proficient enough. In turn, they blame this lack of proficiency on their "abnormal" amount of tough dogs and unusual repairs. This is a false premise. Forever trying to reach an impossible production level only leads to long hours and frustration. It also leads to inadequate test equipment and poorly paid employees, which translates into poor or incompetent service for the consumer.

Calculate the rates your shop should be charging, using the methods shown in this chapter. It's easy to do and will give you a more exact picture of how you can make a success out of your present business. □

	Rate		10% Inflation	New Rate
Hourly Rate	$18.30	X	1.1	$20.10
Service Call	$18.30	X	1.1	$20.10
Bench Repair	$55.00	X	1.1	$60.50

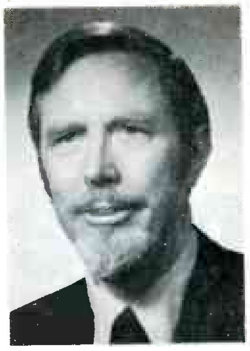
Chart 8-5. Shop B's Service Rates Adjusted for Inflation

	Old Rate		45% Increase		10% Inflation	New Rate
Hourly Rate	$15.00	X	1.45	X	1.1	$23.93
Service Call	$15.00	X	1.45	X	1.1	$23.93
Bench Repair	$45.00	X	1.45	X	1.1	$71.78

Chart 8-6. Shop B's Service Rates Adjusted to Include 45% Increase and 10% Inflation Increase

"Read two books and call me in the morning."

SERVICING ELECTRONIC ORGANS



Part 5/By Norman H. Crowhurst

Digital circuits now are found in some newer model organs. Here is the information you need to recognize them and to troubleshoot them.

The designers of new organs are using more digital-logic techniques in the continuing merchandising struggle to offer more organ features for less money. Generally, the new circuits involve **logic,** or **gating.** Both originally were developed for fields other than audio or organs. It's essential that we keep straight the differences and similarities between these two basic circuits.

One problem is in knowing the exact definition of "analog" and "digital". Standard dictionaries are of no help, and technical ones also are rather vague. Often they try to define by explaining what is done.

"Analog" refers to information of any value; therefore, analog output is continuously proportionate to the stimulus (input). In electronics, an analog output signal is a duplication of the input, which has many voltage levels in each cycle. Only the overall amplitude should be different. An analog computer measures voltages, resistances, etc.

"Digital" refers essentially to "digits", the numbers 1, 2, 3, etc., and digital computers operate with numbers expressed as digits. Usually, digital waveforms are square waves or pulses of constant amplitude.

Logic

Logic circuits are strictly digital in nature, and the signals used in logic are usually "two state". In other words, the signal voltage either is there, or it is missing. A few might be 3-state types, but those are rare. The important point here is that digital-logic circuits cannot handle analog (audio) signals. Usually there are no adjustments, and all signals have the same amplitude.

The "bit" is the basic unit of digital logic, and it represents the "state" of the signal at any specific time. The bit has only two possible states: "high" or "low". These are called by many names. High state is 1, yes, positive, true, or active. Low state is zero, no, negative, false, or inactive. In the illustrations here, we will use "+" as high and "0" for low.

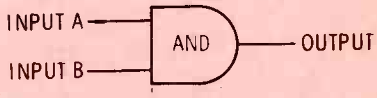
Gates

"Gates" make up one category of digital building blocks. These gates are quite different from the simple on/off gating of organ notes which will be described later.

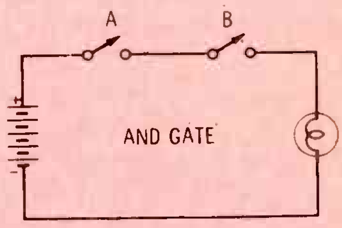
The gates we are illustrating all have two inputs and one output, and the output state depends on **both** of the input states. Each basic gate has a "truth table" which is a simple way of showing the operation. For example, examine the "AND" symbol, the example using simple switches, and the truth table in Figure 1.

It would require a long paragraph to give the four states of the AND gate. For example, both switches open would result in the bulb not being lit. Switch "A" open and switch "B" closed would prevent the bulb from lighting. And so on, for many words. But a glance at the truth table shows us that **both** switches must be on (high) for the output to have power (high). **All other conditions prevent any output** (high).

Figure 2, Figure 3, and Figure 4



(A)
AND SYMBOL

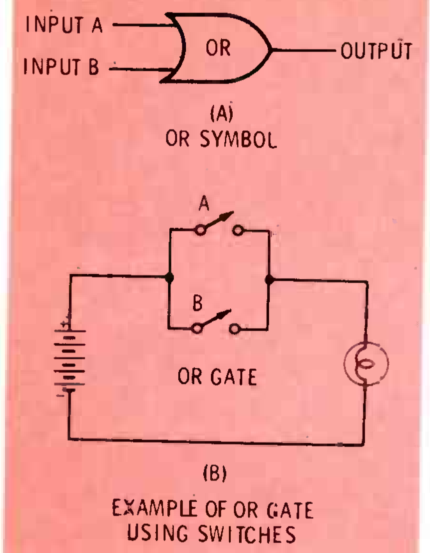


(B)
EXAMPLE OF AND GATE USING SWITCHES

A	B	OUTPUT
0	0	0
0	+	0
+	0	0
+	+	+

(C)
AND TRUTH TABLE

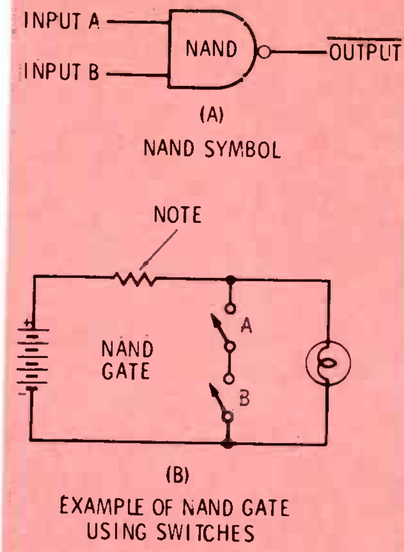
Fig. 1 Both inputs of **AND** gates must be "high" before the output goes "high". (A) This is the usual symbol for **AND** gates. A simple example of **AND** gating with switches and DC components is shown in (B). A truth table for **AND** gates is at (C). Translated, the four lines of the table say: neither input high gives a low output; A high and B low gives a low output; B low and A high gives a low output; and finally, both A and B high produces a high at the output.



A	B	OUTPUT
0	0	0
0	+	+
+	0	+
+	+	+

(C)
OR TRUTH TABLE

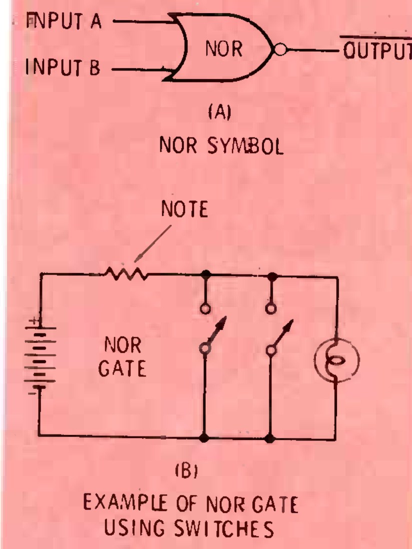
Fig. 2 These are the symbols, a simple example using switches, and the truth table for **OR** gates. Both inputs must be "low" before the output can be "low".



A	B	OUTPUT
0	0	+
0	+	+
+	0	+
+	+	0

(C)
NAND TRUTH TABLE

Fig. 3 A **NAND** gate means "not **AND**", or the opposite of **AND**. A **NAND** gate can be made by adding an inverter at the output of an **AND** gate. Both inputs of a **NAND** gate must be "high" before the output can be "low."



A	B	OUTPUT
0	0	+
0	+	0
+	0	0
+	+	0

(C)
NOR TRUTH TABLE

Fig. 4 A **NOR** gate is the opposite of an **OR** gate; a **NOR** gate can be made from an **OR** gate by adding an inverter to the output. Both inputs to a **NOR** gate must be "low" before the output can be "high".

illustrate OR gates and the opposites of AND and OR, the NAND and NOR gates. These latter two mean "Not AND" and "Not OR".

Of course, the actual digital gates are specialized kinds of IC units, with the switching done internally by diodes and transistors according to the input voltages. Most digital diagrams do not show the power supply, but each gate must have one or more.

Closely related to the gates are "inverters", as shown in Figure 5. An AND gate can be changed into a NAND gate merely by adding an inverter after the AND gate.

Flip-Flop

Another popular digital circuit is called "flip-flop", and a typical circuit is shown in Figure 6. If the diodes were omitted, and both R2 and R4 replaced by capacitors, the circuit would be a free-running multivibrator. But without capacitors between the collector of one and the base of the other, it is a flip-flop, which changes state each time it is triggered, and then remains that way until triggered again.

With the complete circuit as shown (sometimes small capacitors must be placed across R2 and R4 for best triggering), the output state is reversed for every **two** input pulses.

To sum up, a flip-flop can be used as a latching switch, with the "positive" and "negative" outputs giving the effect of a double-pole action, and when a continuous digital signal comes in through C1, the output repetitive frequency is just one-half that of the input trigger signal. In other words, **a flip-flop can be a frequency divider.**

Digital Organ Circuits

One of the simple jobs for digital circuits in organs is in keying the individual notes (Figure 7). Remember, with an AND gate, there is no output until **both** inputs are high.

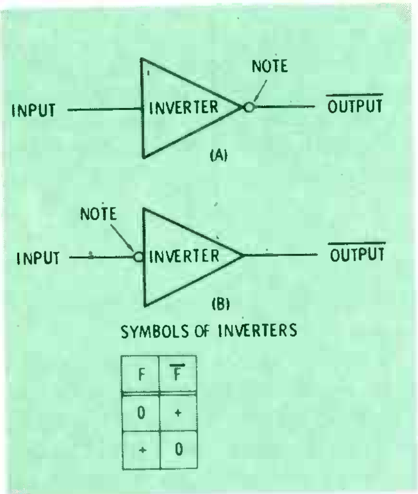


Fig. 5 A digital inverter changes the output phase by 180 degrees. The symbol is the triangle representing a stage, with a small circle at either the input or the output.

A negative or zero voltage at the keying input prevents any output signal, and a positive keying voltage allows the signal at the other input to pass through.

This kind of circuit works only with a signal of pulses and square waves, because the gate is digital. But that is not as serious a limitation as you might imagine, since those waveforms are useful for music.

Square waves (Figure 8A) have a fundamental and odd harmonics of gradually weakening amplitude. Pulse signals, as drawn in Figure 8B, have a fundamental plus both odd and even harmonics; also, the harmonics are stronger than with any other waveform. Sawtooth waveforms (Figure 8C) have both odd and even harmonics that are weaker for the higher ones.

In one successful design, both the square and pulse outputs of the same note are keyed by separate AND gates, with the outputs going through formant filters (Figure 9). Of course, following the digital keying, the amplifier circuits are all analog.

Synthesizing Sawteeth

Figure 10 shows how an approximate sawtooth (with both odd and even harmonics) can be constructed by adding three octaves of square waves. A separate gate could key each octave. One advantage of digital circuits is that many can be housed inside a small package, and at reasonable cost.

Analog Gating

Analog gating permits a more gradual transition from off to on, and from on to off. One of the simplest circuits uses two diodes, arranged so both increase or decrease resistance at the same time from the application of different amounts of forward bias (Figure 11).

When diodes are used to key sine waves, and the signal amplitude is high, clipping occurs in the interval between off-and-on, or on-and-off (Figure 12).

But don't let that blind us to another possible condition. Diodes can be biased between the forward bias that gives full conduction and zero bias. In that range, there are many values of forward bias that produce diode resistances of several thousand ohms.

When the AC signal has low amplitude, a diode can be made to function as a variable resistance, and without much clipping of the signal. Unfortunately, the schematic will not indicate whether the clipping is heavy or light.

Another way of keying (Figure 13) is to use a diode that is biased heavily so it shorts out the signal until the note is keyed. Of course each diode must be isolated by a resistor from the input, to prevent loading the tone source; also, it must be isolated from the common tone output to prevent loading the audio of other notes.

Better keying results from two diodes (Figure 14) arranged with one in series and one as a shunt. In this case, the series diode isolates the circuit from the tone source, but a resistor still is needed to isolate the shunt diode from the output.

Another shunt circuit uses the

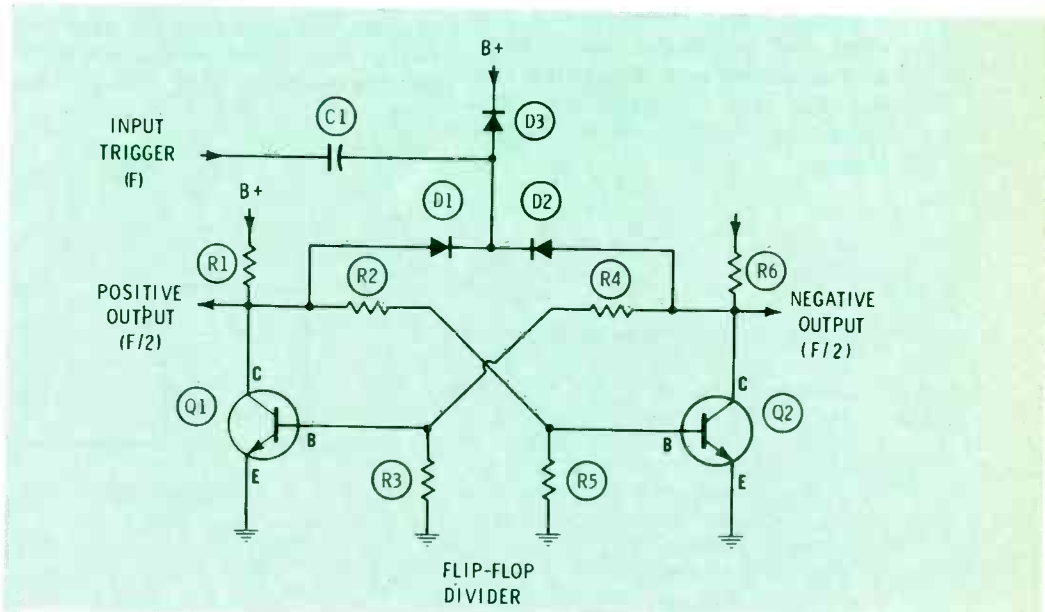


Fig. 6 A flip-flop divider resembles a multivibrator, but it will not oscillate because there are no major coupling capacitors from Q1 base to Q2 collector and from Q2 base to Q1 collector. If there is no triggering signal, the circuit always stabilizes with one transistor cutoff and one saturated. When the negative edge of a triggering signal comes in through D1 or D2, it reduces the voltage of whichever collector is positive; thus causing a reversal of which transistor is saturated and which is cutoff. Therefore, **two** input pulses are required to produce **one** output square wave. That's why it's called a divider; the frequency is divided by half. Diode D3 clips most of the positive peak of the triggering signal, giving more dependable operation.

collector/emitter path of a transistor as the shorting element, and this C/E resistance is determined by the B/E bias (Figure 15). When the key switch is open, a heavy forward (positive) bias is applied, and the saturated C/E shunts all the audio to ground. Closing the key switch brings in a negative voltage which reverse biases the base, and the resulting high C/E resistance permits the audio to pass through with little attenuation.

Another transistor circuit giving low-impedance input and some gain is shown in Figure 16. Audio enters the emitter (grounded-base circuit). When the key switch is open, positive voltage (reversed bias for the PNP) fed to the base keeps the transistor cut-off. Closing the key switch brings in a negative voltage which is sufficient to overcome the positive voltage and provide a normal negative forward bias so the transistor conducts and has gain. Outputs of all the keying transistors are paralleled without isolation, because each transistor is open when it isn't keyed on.

Musical Effects From Gating

Gating circuits not only can produce the percussive and guitar-like sounds with variable amplitude, but also are the basis for other special effects achieved by modern organs.

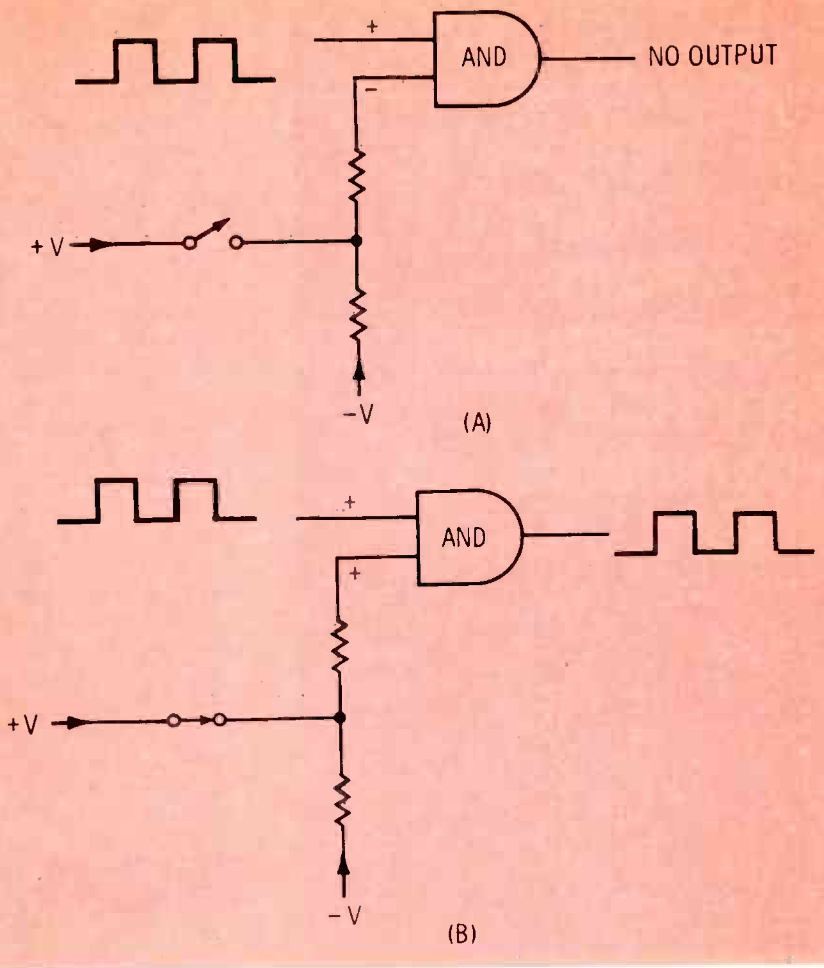


Fig. 7 A digital **AND** gate can be used to key either square waves or pulses in an organ. Remember that **both** inputs must be "high" (positive) for the output to be positive. When square waves come in to Input A, but Input B is slightly negative, the output has no waveform, as shown in (A). But if a positive DC voltage equal to the usual "high" signal is applied to Input B, as diagrammed in (B), the output is "high" every time Input A is "high" from the input square wave.

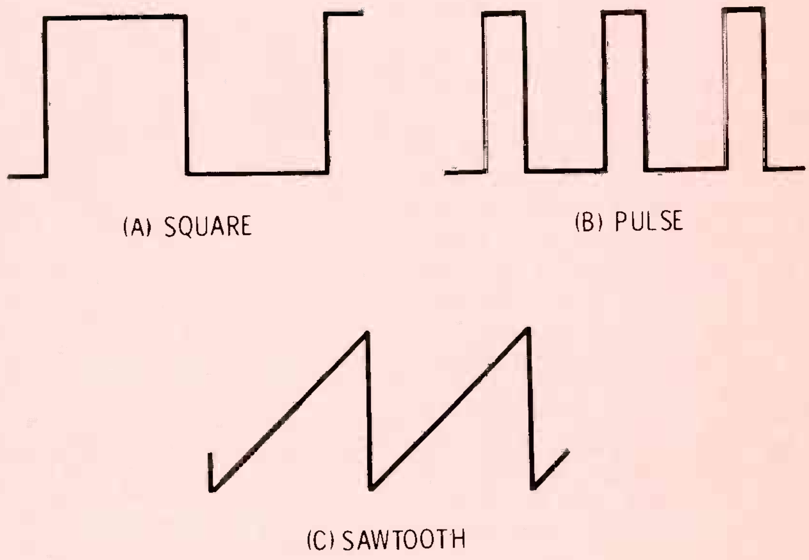


Fig. 8 These three basic organ waveforms have widely-different harmonic characteristics. (A) Square waves have 100% fundamental, no second harmonic, 33% third, no fourth, 20% fifth, no sixth, 14% seventh, and so on for all the remaining harmonics in decreasing amplitude. (B) Pulses have no strict formula, because it changes with the pulse width, but one kind of pulse might have 100% fundamental, 100%, second harmonic, 100% third, 100% fourth, 100% fifth, etc. (C) Sawteeth have 100% fundamental, 50% second harmonic, 33% third, 24% fourth, 20% fifth, 16% sixth, etc. Square waves have no even harmonics, but the others have both kinds.

For example, suppose an inexperienced organist wants to play a single-finger melody on the upper manual and a chord on the lower keyboard. And yet, he wants more than a sustained chord. Flip a switch, labeled with some ad-man's flight of fancy, and the organ will break up the chord into arpeggios (notes in succession, not together). Or it will play the chord in an appropriate rhythm. Also, some models will select a pedal note from the chord and play it in rhythm.

All of these things are possible

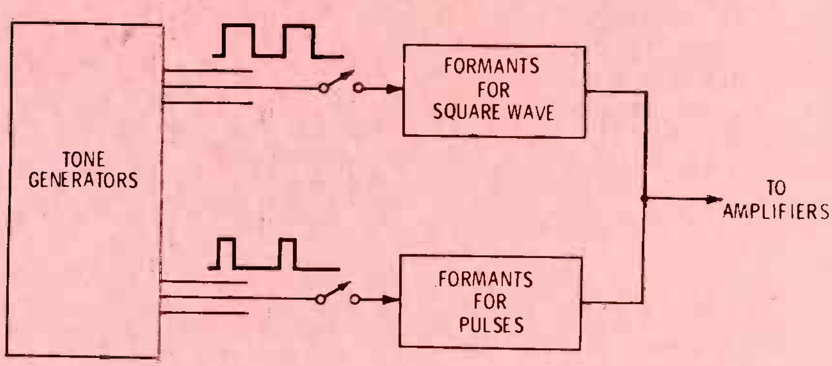


Fig. 9 Square waves or pulses can be handled by digital gating circuits, because those signals either are there or they are missing.

Fig. 10 A passable imitation of a sawtooth waveform and acoustic tone quality can be made by adding two or more octaves of square waves, each higher octave being 6 dB lower in amplitude. Mathematically, the first higher octave supplies the missing second harmonic, the next gives the missing fourth harmonic, and so on for as many octaves as the designer has supplied. Two such octaves are the minimum that can be used for satisfactory musical tone quality.

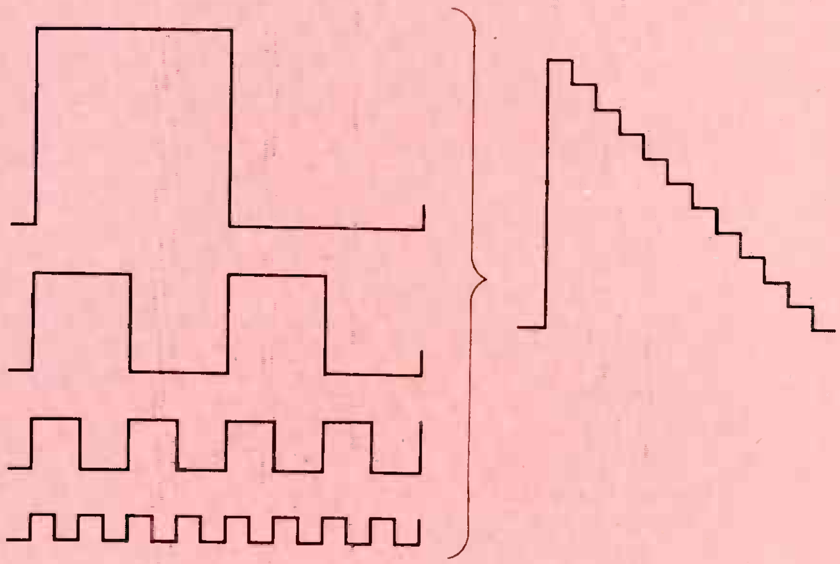
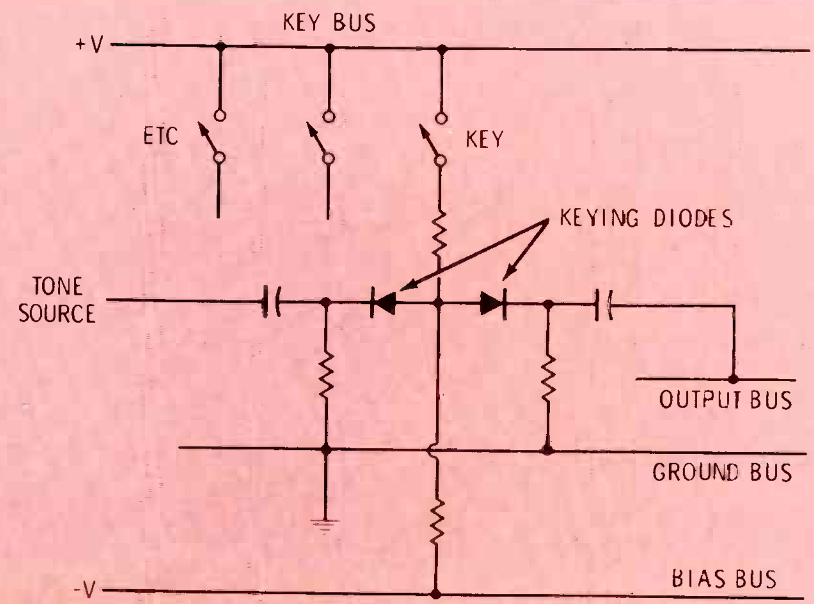


Fig. 11 Keying-diode circuits basically are analog in nature; however, the use of very high positive and negative supply voltages can give rapid keying. Usually instantaneous keying is not desirable, since it can cause pops and clicks. In this example, both diodes are cut off by reverse voltage until the key switch brings in positive voltage to make the anodes positive.



because of gating circuits, operated by electronic logic circuitry. Usually, to avoid double notes, the automation disables the regular function of the pedals, This requires more logic circuitry.

Alternately, the organist might play one pedal with his foot, and the organ will play a sequence of bass notes (for example, the Gulbransen "walking bass" feature).

Troubleshooting Modern Organs

The service manuals provided for earlier-model organs included a section on troubleshooting, covering various possible faults, and making suggestions about what to look for and how to make tests.

Organ Manufacturers

Allen Organ Company,
Macungie, PA 18062

Baldwin Piano Company,
1810 Gilbert Avenue,
Cincinnati, OH 45202

Conn Organ Corporation,
Elkhart, IN 46514

Gulbransen,
8501 West Higgins Road,
Chicago, IL 60631

Hammond Organ Co.,
4200 Diversey,
Chicago, IL 60639

Kimball Piano and Organ Co. Inc.,
1111 E. 15th Street,
P.O. Box 460, Jasper, IN 47546

Lowrey Company,
7373 N. Cicero Avenue,
Lincolnwood, IL 60646

Rodgers Organ Co.,
1300 N.E. 25th Avenue,
Hillsboro, OR 97123

Wurlitzer Organ Co.,
De Kalb, IL 60115

Yamaha International Corp.,
P.O. Box 6600
Buena Park, CA 90620

Thomas Organ Co.,
8345 Hayvenhurst Avenue,
Sepulveda, CA 91343

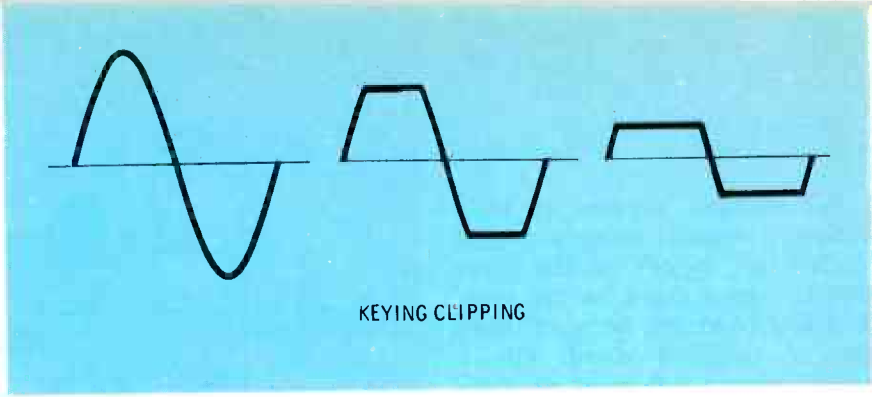


Fig. 12 When diode-keying circuits are slowed down to permit percussion effects, it's possible for one or more peaks of the signal to be clipped as shown here with a changing keying voltage. However, if each individual note is keyed, the clipping merely changes the tone quality (amplitude of the harmonics), and does **NOT** introduce intermodulation distortion. Remember that intermodulation distortion is probably the worst kind, because it produces sum-and-difference frequencies which are not harmonically related to the original note.

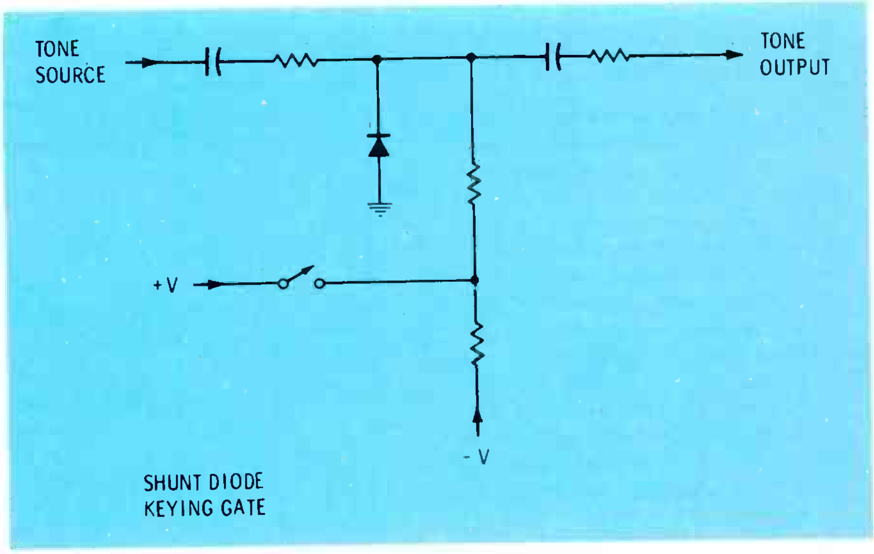


Fig. 13 A diode can key an organ note when it's used as a shunt, which shorts out the signal when the cathode is negative, and becomes an open circuit when the cathode is positive from voltage through the keying switch.

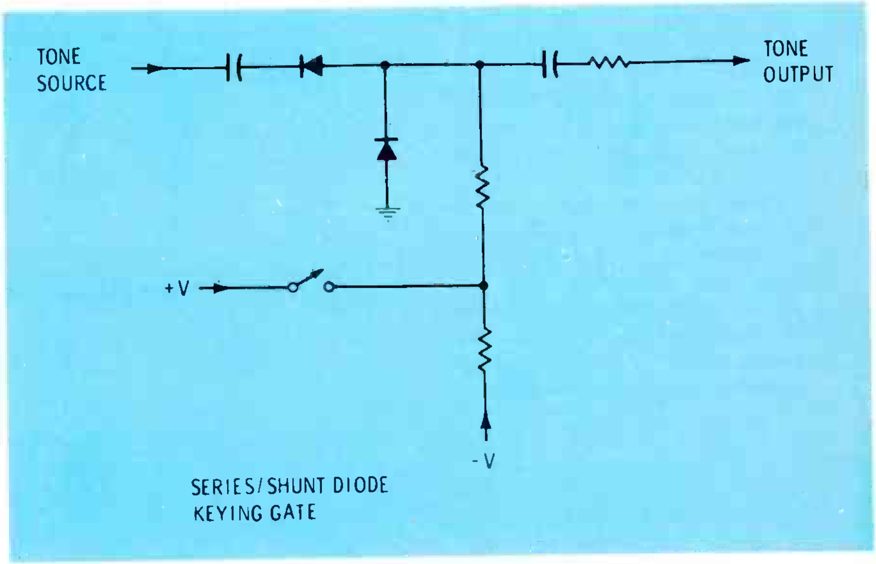


Fig. 14 Less "leak-through" of audible sound occurs when two diodes are used for keying. One is in series, and the other is a shunt.

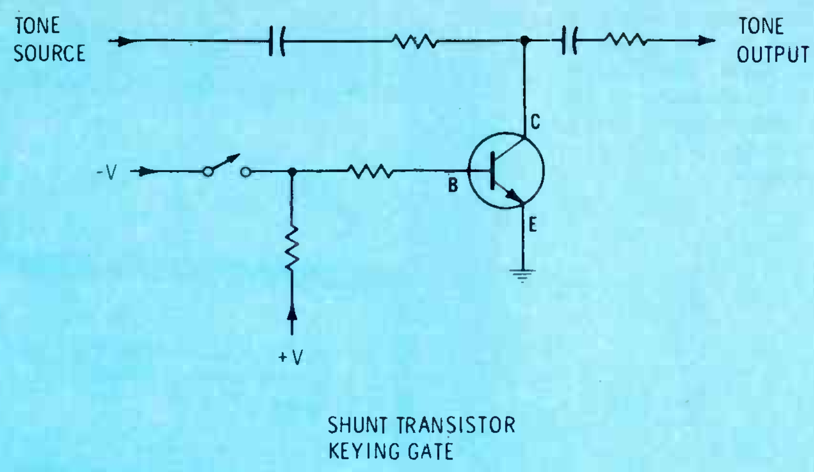


Fig. 15 A transistor, also, can be used as a shunt element, giving less clipping than with diodes. The forward bias determines the C/E resistance.

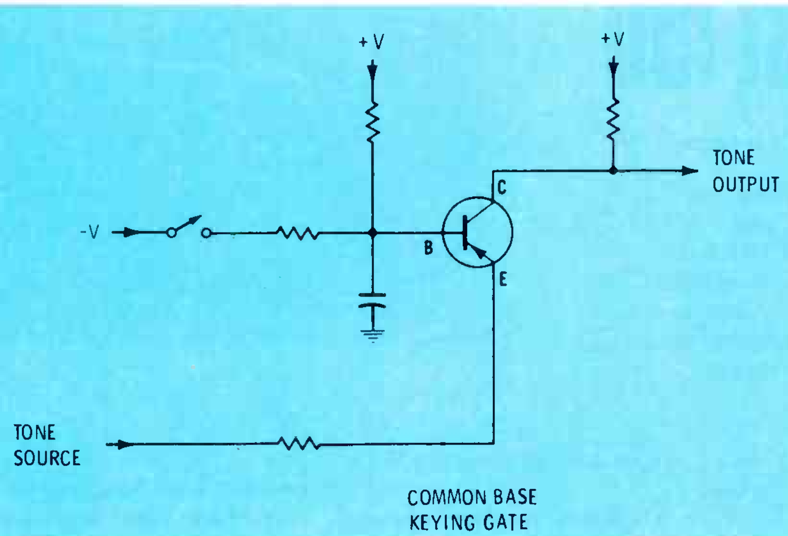


Fig. 16 The keying transistor also can produce gain, when wired this way. To the tone input, the transistor is a "grounded-base" amplifier.

None of the more-recent manuals do this. The reason that the servicing section is missing is simple: the circuitry is so complex that it is virtually impossible to predict all of the possible defects, or even the major ones. Further, it is equally impossible to predict the causes for such faults.

Therefore, the best way to work is to start with the more-logical explanations for the symptoms. If these don't work out, then study the system in more detail and look for less-probable explanations. After you have found the defect, chances are you will think, "Who would have predicted that cause of the problem?"

Newer models of organs make factory manuals even more essential. Although older ones often can be repaired even when you have little else than merely a knowledge of the general principles of operation, that is not sufficient for any modern full organ.

Before you have seen a complete manual, it's likely you cannot imagine the pages and pages of **partial** schematics that are required. Of course, the reason is that every circuit must be repeated for every note and function. It's been years since I saw an organ schematic that was complete in one drawing.

How much to charge? I can't tell you. Naturally, there is the comparison of the original cost of the organ versus what the repairs might cost. Also, the newer organs give more features for the dollar, and the owner might want to update to a better one.

On the other hand, an organist might have grown fond of that model of musical instrument; it's more like a member of the family. Price is less of a consideration in such cases.

Unless you are certain of the customer's reaction, pe aps it's best to quote an estimate and wait for a reaction to guide you into further recommendations.

Chart 1 lists most of the organ manufacturers, their addresses, and the names of the men to contact when you want service data or have questions.

Next Month

Several methods of tuning organs will be discussed next month. □

Fig. 1 This is the Sencore Model CB41 Automatic Performance Tester, which is designed to test RF-power output, SWR, and percentage of modulation of CB radio transmitters without any nulling or calibration adjustments.

Reports from the test lab

By Marvin J. Beasley, *CET, Technical Associates, Inc.*

Each report about an item of electronic test equipment is based on examination and operation of the device in the ELECTRONIC SERVICING laboratory. Personal observations about the performance, and details of new and useful features are spotlighted, along with tips about using the equipment for best results.

Automatic Tester For CB

It is a pleasure to operate any item of test equipment that makes troubleshooting easier, quicker, and more accurate. One example is the Model CB41 CB Automatic Performance Tester by Sencore (Figure 1).

Other instruments can do the same basic test measurements, but the strong feature of the CB41 is implied by the word "automatic". Before most other testers can read RF wattage, VSWR, or percentage of modulation, they must be balanced or calibrated for the exact signal level actually emitted by the transmitter. When the conditions or the signal levels change, the instrument must be re-calibrated. So, if you calibrate the meter each time, the accuracy can be good, but the procedure is complicated and much time can be wasted. On the other hand, if you fail to balance, you can obtain wrong readings.

These problems are solved in the CB41 by the IC's and other components which eliminate the balancing or user-operated calibrations.

Next, the CB41 has flat response between 20 MHz and 30 MHz; therefore, it can be used for any channel within that range, including all those provided by the new 40-channel model CB transceivers when they become legal next January, 1977.

Each CB41 is packed with a 32-page instruction manual and a cassette tape which has many of the same instructions. Actually, it's so easy to connect the meter and make the readings that two or three pages would be sufficient. The other pages are devoted to applications tips and hints about typical CB defects and how to find them.

Features

Some of the features of and facts about the Sencore CB41 include:

- Power for operation comes from two paralleled 9-volt batteries, which are mounted inside the top cover;
- For operation from external power, a Sencore PS43 power adapter can be plugged into the rear of the case. Batteries must be connected inside to act as filters when the power adapter is used;
- The front of the "Push On" button appears to be illuminated by a neon bulb, when it is pressed in and latched to turn on the power. However, the orange color comes from a filter that's moved mechanically, and it is the same color even without any batteries or other power. A "Batt Test" button on the right edge shows the battery-voltage reading on the meter, when the button is pressed momentarily.
- Three latching-type pushbuttons select the functions of "RF Watts", "SWR", or "% Mod";
- There are no other controls on the front panel;
- Calibrations on the scale of the 4-1/2-inch meter give the readings for the three functions, plus a green-yellow-red extra scale for SWR readings, and a green area for battery voltage;
- A sliding cover can be moved up

Fig. 2 Only two connections to the sensor unit are required. The meter operates on internal batteries, and an optional extension cable can be obtained to permit using the sensor unit at the radio, and the meter at the antenna (where antenna-tuning adjustments can be made). The CB41 is reading 4 watts of power. Also shown are the printed manual and the familiarization cassette tape. Operation is so easy that you will not need the book after the first set of measurements, except for the many valuable servicing tips that occupy most of the book. The maximum of 25 watts should not be read for long on the dummy load, to prevent damage.

Fig. 3 Changing to SWR readings only requires sliding one sensor switch, and depressing the "SWR" button on the meter. Of course, SWR readings should be done with the antenna. Between 1 and 15 watts are necessary to allow the best accuracy of readings. The SWR of 3.5:1 was taken with my own antenna. At first, I couldn't believe it, but the accuracy was verified with other meters; my antenna was defective!

Fig. 4 Percentage-of-modulation tests can be done either on the dummy load or with the antenna. To minimize interference, it's recommended that the dummy load be used for all preliminary or troubleshooting tests for power output and modulation. The Royce used to supply the signal has good modulation limitation, so it could not be forced to above 68% average for speech (that corresponds to about 90% on peaks).

to protect the meter face during transportation or storage;

- The 39G101 Sensor unit is stored inside a compartment in the back, and the cables permit it to be removed and operated outside the case. (Each sensor is factory-calibrated with that one meter assembly, and is wired to it by a cable and connectors. For best accuracy, each matched set of sensor-and-meter should be used together, and not interchanged with others);
- A slide-switch on the sensor selects either the built-in 50-ohm, 6-watt dummy load, or an external antenna. A cable with a PL259 male coaxial plug brings in the signal from transmitter to sensor, and a sensor-mounted female PL259 socket sends the signal out to an antenna through the selector switch;
- An extension cable is available permitting the sensor to remain at the radio and the meter to be near the antenna; and a PA202 power adapter can be used for operation from rechargeable batteries.

RF-Power Tests

Figure 2 shows the simple hook-up of the CB radio and the CB41. The sensor is removed from the meter case (allowing easier access to the switch and plug), the cable and male connector plug into the radio, the power switch is depressed, and the "RF Watts" button pressed on the tester. At the sensor, the switch is slid to the "50-Ohm Dummy Load" position. That's all. When the unit is keyed to transmit, a reading should show on the top meter scale.

Now, the power reading is in Peak Envelope Power (PEP), which gives an advantage plus one precaution. Without any amplitude modulation, the output power should read the same with the CB41 PEP, an average-power meter, or by voltage/resistance calculation. For this test, the FCC limits the output to 4 watts.

When a transmitter is amplitude modulated at 100%, the maximum allowed is 12 watts PEP, and this will read on the meter. Other meters which respond to **average** power show little change with modulation. Therefore, the CB41 can show the carrier power when there is no modulation, or the modulated power with modulation. Sometimes this combined test can be an advantage in evaluating the performance.

RF power output from a Single-SideBand (SSB) transmitter should be zero without modulation. If there is an appreciable power reading, the transmitter needs repairs. With 100% SSB modulation, the maximum legal power should not exceed 12 watts PEP. The CB41, therefore, indirectly measures SSB modulation on the power scale.

SWR Tests

Because no nulling or calibration adjustments are needed, the SWR tests are equally simple. Just switch the sensor to "Ant" and the meter to "SWR" (Figure 3). In addition to the usual calibration of SWR ratio from 1:1 to infinity, a color-coded arc shows the range of permissible, questionable, and not-satisfactory SWR.

Modulation Tests

Switch the sensor back to the dummy-load position, and depress the "% Mod" button on the meter (Figure 4). Modulate the trans-

(Continued on page 54)

STACK UP PROFITS WITH THESE NEW HEATH AUDIO SERVICE INSTRUMENTS!

NEW!
IM/SM-5248
as low as
$169^{95} kit

An IM distortion analyzer that's designed for professional audio servicing. The lowest range, 0-0.1% (readable to 0.01%) with 5% full scale accuracy gives you all the readability and accuracy you need for testing the most modern audio equipment.

Conformance to both SMPTE and IEEE standards is insured by use of internal 60 Hz and 7 kHz oscillator outputs. Rear panel jacks allow use of external generators for other standards. Built-in AC voltmeter with a dB scale adds even more convenience to the unit. Universal five-way binding posts let you use the analyzer with virtually all associated equipment – without special cables or adapters.

Features, range and accuracy at an incredibly low cost. The 5248 Intermodulation Distortion Analyzer shows you the way to put audio service profit on your service bench.

A factory tested and calibrated version costs only $250.00.

NEW!
IM/SM-5258
as low as
$219^{95} kit

A harmonic distortion analyzer with auto-null for less than $1000! Simply "rough-tune" the analyzer and flip the AUTO mode switch. The analyzer automatically balances, eliminating the need for delicate and time consuming fine-tune adjustments. Service dollars move off your bench in less time.

Harmonic distortion measurements as low as 0.03% can be made on the 0-0.3% range over a frequency range of 5 Hz to 100 kHz allowing you to check and service amplifiers and receivers claiming the finest specifications. Residual distortion is less than 0.03% and the meter is accurate to within 5% of full scale over five ranges. A built-in AC Voltmeter with full scale ranges from 1 mV to 300 VAC makes your THD measurements move even faster.

A perfect companion instrument to the 5248, the 5258 is a superb quality, low-cost addition to your audio service bench!

A factory tested and calibrated version costs only $330.00.

NEW!
IM/SM-5238
as low as
$89^{95} kit

The superb 5238 AC Voltmeter is the first to offer both a 3-decade linear dB scale *and* linear voltage scales. Not the familiar log function scales found on other voltmeters. Easier measurements mean less time and more profit.

Twelve voltage ranges, from 0-1 mV to 0-300 VAC, with an accuracy of 4% of full scale, provide all the meter capability you'll ever require. dB measurements can be made from −70 to +40 dB over twelve ranges in 10 dB increments with an accuracy of ±0.5 dB. The measurable frequency range is 10 Hz to 1 MHz ±1 dB. This is the AC Voltmeter for your service bench.

If you ever have had to measure low level signals, such as ripple or noise in a power supply, the 5238 now gives you the scale legibility you want from a meter.

Rear panel amplifier output and DC outputs proportional to meter reading for direct recorder connection enhance the unit's versatility. Now is the time to add the 5238 to your service equipment inventory.

A factory tested and calibrated version costs only $130.00.

Order your profit makers now!

For exactly the range, accuracy, versatility and dependability you need to make your audio service profits grow, order all three suberb Heath/Schlumberger audio service instruments today!

Heath Co, Dept. 25-22
Benton Harbor, MI 49022

HEATH
Schlumberger

Heath Company, Dept. 25-22
Benton Harbor, Michigan 49022

Gentlemen, please send me:

☐ IM-5248 IMD Analyzer in kit form at $169.95 (add $2.75 for shipping and handling).
☐ SM-5248 IMD Analyzer in assembled form at $250.00 (add $2.75 for shipping and handling).
☐ IM-5258 THD Analyzer in kit form at $219.95 (add $3.00 for shipping and handling).
☐ SM-5258 THD Analyzer in assembled form at $330.00 (add $3.00 for shipping and handling).
☐ IM-5238 AC Voltmeter in kit form at $89.95 (add $1.75 for shipping and handling).
☐ SM-5238 AC Voltmeter in assembled form at $130.00 (add $1.75 for shipping and handling).

Michigan residents add 4% sales tax.

I enclose a ☐ check ☐ money order for $________; or, charge to my:
☐ BankAmericard Acct. No.________ Exp. Date________
☐ Master Charge Acct. No.________ Exp. Date________
If Master Charge, Include Code No.________

Signature: X________

Name: (please print)________

Address________

City________ State________ Zip________

TE-340 Prices and specifications subject to change without notice.

For More Details Circle (23) on Reply Card

Test Lab Report

(Continued from page 52)

mitter by whistling steadily or humming into the microphone, and the meter reads (on the lower scale) the percentage of modulation. Most transceivers will allow 80% or even 100% readings. If not, the RF output and driver stages or the modulator in the transmitter probably need repairs.

Comments

I did not realize how much time was required to do the many nulling and calibration adjustments that are necessary with the conventional CB test instruments, until I worked with the Sencore CB41 which does not require any such adjustments. The elimination of the calibration steps gives a feeling of freedom, and removes the pressure associated with the need for accurate adjustments.

When checked against other meters, the Sencore CB41 appeared to have very good accuracy, and I encountered no problems of any kind with it. □

test equipment report

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

Frequency Counter

Lectrotech has introduced a new 50-MHz frequency counter. The Model FC-50 counter has a full 8-digit display which permits frequency measurement to a resolution of one Hz. The large digit size permits viewing at distances up to 20 feet. The counter uses LSI (Large Scale Integration) to reduce the IC package count.

The small size and rugged construction plus the ability to operate from 12-V DC power (car battery) permits portable operation in the field. A full line of optional accessories is available for use with CB equipment.

The Model FC-50 is priced at $199.50.

For More Details Circle (35) on Reply Card

CB "Sleuth"

RF interference now can be pinpointed with **Channel Master's** new "Sleuth" RF noise detector.

The "Sleuth" is easy to use. It is a 25" long rod, about 1" in diameter at the end of a 17-foot length of coaxial cable, which in use is connected to the antenna terminals of the CB transceiver or radio. The other end of the rod is pointed at suspected noise sources under the hood of the vehicle. When the detector is near the source of RF noise, the audible noise will increase in the radio speaker. The problem can be eliminated by installation of the proper noise suppression device.

The "Sleuth", Model 5270, is constructed of non-conductive PVC tubing. The coaxial cable is fitted with an assembled PL-259 type connector. Suggested retail price is $16.95.

For More Details Circle (36) on Reply Card

CB Meter

A new three-way meter (Model M-272) that provides accurate measurement of CB system performance now is available from **The Antenna Specialists Company.**

Combining three CB test instruments into one compact case, the M-272 serves as a wattmeter, a modulation bridge, and a VSWR bridge. Separate scales are provided for each function with a tri-level wattmeter scale for 10/100/1000 watts.

Suggested list price is $59.95.

For More Details Circle (37) on Reply Card

3½-Digit Multimeter

A portable 3½-digit multimeter with RMS-responding AC readings for measuring signals with as much as 10% distortion is now available from **Ballantine Laboratories.**

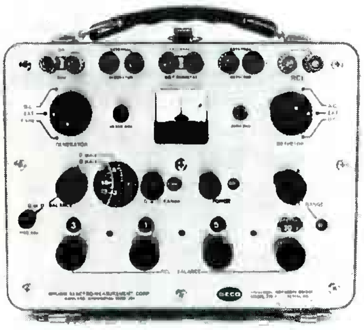
The Model 3028A digital multimeter offers autopolarity, autozeroing, six functions, and thirty ranges with clear digital readout on a 0.43"-high LED display, with a test mode to check the display. AC bandwidth is from 15 Hz to 200 kHz. It features HI or LO Ohms modes for diode or in-circuit resistance tests; all functions are protected from overloads up to 1200 volts on any voltage range, and 285 volts DC plus AC on any ohms range. The instrument measures AC/DC voltages from 100 microvolts to 1200 V in five ranges; AC/DC current from 100 nanoamperes to 2 amperes in five ranges; and resistance from 0.1 ohm to 20 megohms in ten ranges.

Cost of the Model 3028A is $279, with the optional internal rechargeable Nicad battery an additional $45.

For More Details Circle (38) on Reply Card

Impedance Bridge

The 315A is a portable, battery-powered, universal impedance bridge from **Brown Electro-Measurement Corporation.**



It has a five-place direct readout with an automatic lighted "floating" decimal. The parameter and its magnitude is also displayed. The bridge measures resistances from zero to 12 megohms with a resolution of 0.1 ohms, capacitances from zero to 1200 microfarads at 0.01 picofarads, and inductances from zero to 1200 Henries at 0.01 Henry. Accessory generators and detectors can be used to solve special problems.

The bridge can be used for rapid checking of tolerances for inspection, because the meter readout is linear.

Price of the Model 315A Impedance Bridge is $755.

For More Details Circle (39) on Reply Card

Frequency Counters

Systron-Donner has introduced a new series of communications counters. Model 6241A measures frequencies from 20 Hz to 100 MHz, Model 6242A measures from 20 Hz to 512 MHz, and Model 6243A covers the range from 20 Hz to 1,250 MHz. Features common to all three units include: 10 mV sensitivity; ability to withstand high input signal levels; fuse-protected RF input (Models 6242A and 6243A); full 8-digit LED display; selectable resolution in decade steps from 10 kHz to 0.1 Hz; and a high-stability timebase oscillator offering ± 2 parts in 10 million per year.

Available optionally are: a tone multiplier mode; a TCXO; 1-2-4-8 coded digital outputs; and frequency-expansion kits to upgrade to 512 MHz or 1,250 MHz.

Suggested prices are: Model 6241A, $595; Model 6242A, $795; and Model 6243A, $995. □

For More Details Circle (40) on Reply Card

productreport

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

CB Tapes

A cassette-tape series that presents the ABC's of CB in easy-to-understand fashion has been produced by **Edu-Tronics.**

Two tapes for CB customers now are available; a third tape is being revised completely pending new FCC regulations regarding 40-channel CB operation. Tape One, which serves as an introduction to CB, is geared to the person who is thinking of getting into citizens-band radio. General CB information plus buying and installation tips are covered in depth. Tape Two is more technical in nature, and provides a complete presentation on CB accessories; what they are, how they can improve performance, and how they operate. When available, Tape Three will be devoted to the upgrading of CB equipment.

Each cassette is 30 minutes in length (15 minutes each side), and is packaged in a plastic box. A colorful narration is provided by Jack Baker, a popular announcer at Milwaukee's largest radio station.

Suggested list price for individual cassettes is $12.95.

For More Details Circle (41) on Reply Card

CB Base Station

Kris Incorporated has a new base-station system with a choice of either the Kris Victor or Victor II 23-channel AM transceivers, a matching "Basemate" AC power converter, and the Kris Model 416-401 base-station microphone.

While both Kris Victors are identical in performance, the Kris Victor II has a bright-red LED digital channel readout. Both models feature full legal power, a double-filtering system, stronger-than-steel foam cover, automatic noise limiter (ANL), built-in noise suppression, and 100% modulation capability (thereby eliminating the need for pre-amplified type microphones). The matching "Basemate" AC power converter supplies 13.8 VDC from line power. It has an on/off switch and indicator light. The Kris base microphone is a desk-top unit that features push-to-talk, or a lock position for hands-off operation.

Complete Victor Base Systems (Model 416-223) carry a suggested retail price of $269.95. Complete Victor II Base Systems (Model 416-224) have a suggested retail price of $299.95.

For More Details Circle (42) on Reply Card

Semiconductor Guide

General Electric has released the 1976 edition of its semiconductor replacement guide.

The 200-page guide, ETRM-4311, includes cross reference information for GE universal-replacement semiconductors and application and technical data on the devices. Also included are 52 new entertainment semiconductor devices plus information on five semiconductor kits, 19 experimenter/hobbyist components, and 22 accessories.

Suggested user prices on all devices, accessories and kits are included in the publication. It has a suggested price of $1.

For More Details Circle (43) on Reply Card

Mobile Money Safe

Model PL from **Detroit Mini-Safe Company** is a mini-safe that would be especially useful for route salesmen and outside technicians. It mounts permanently to the floor of a vehicle, and can be padlocked.

As cash is received, it is dropped through a slot in the all-steel welded deposit safe. The safe, measuring 4 X 6 X 10", provides positive protection against hold-ups as the contents can only be removed with the padlock key, which is not kept in the vehicle.

For More Details Circle (44) on Reply Card

Staple Gun

The Model T-37 staple gun tacker from **Arrow Fastener Company** fastens wires up to 5/16 inches in diameter. The tapered striking edge gets into close corners and the grooved guide positions the wires. A grooved driving blade stops the staple at the right height to prevent wire damage. The round-crown staple fits the wire snugly for a neat installation. The all-steel Model T-37 takes 3/8, ½, and 9/16 inch staples. □

For More Details Circle (45) on Reply Card

antenna systems report

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

VHF/UHF Preamps

The Chroma-Power TV antenna pre-amps from **Antenna Corporation of America** now are available in three 300-ohm output models and three 75-ohm output models.

Some features are: high input capability (175,000 MV); high output (1,250,000 MV or 62 dB); weatherproof housing with a lightning-protection diode; and a universal mount for any antenna.

For More Details Circle (50) on Reply Card

Hatchback Antenna

A CB antenna for hatchback and fastback model cars, Model M-432, has been introduced by **The Antenna Specialists Company.**

The latest addition to the A/S line is center loaded, with whip and loading coil pressure-molded into a single weatherproof, vibration-resistant unit.

The "hatchback" trunk-groove mount is fully adjustable, allowing the user to set the antenna in a vertical position. The "static ball" tuning tip eliminates the need for cut-and-try antenna trimming.

Suggested list price of the Model M-432 is $19.95.

For More Details Circle (51) on Reply Card

Co-Phased Antenna

Model SA-25 from **Sparkomatic** is a CB twin antenna that's intended for trucks. The "Long Ranger" is a co-phased twin-mirror-mount antenna for the 27-MHz CB band.

The new antenna has stainless-steel whips, waterproof PVC coil covers, and chrome-plated fittings. A long-life RG-59/U cable provides a low power loss, and the antenna can be tuned for lowest SWR. It can be mounted easily on all truck-mirror brackets, and is adaptable for use on RV's, campers, and pickup trucks. The overall length is 54 inches.

For More Details Circle (52) on Reply Card

CB Trunk Antenna

Antenna, Incorporated now is shipping its Persuader Model 17610 CB trunk-lip-mount antenna in pre-assembled form. In addition, the Model 17610 now includes the company's in-line coaxial-cable connector, previously available only on Antenna display-boxed antennas.

The Persuader comes complete with a base-loaded antenna, 34-inch stainless-steel whip, and a stainless-steel impact spring. The coaxial cable is 17-feet long, and has both a PL-259 connector and an in-line connector. The antenna is designed for a VSWR of 1.5:1 or better, and is weatherproof.

Suggested list price of the Persuader Model 17610 is $25.95.

For More Details Circle (53) on Reply Card

Twin Gutter-Mount Antenna

Mura Corporation has added CBA-4, a twin gutter-mount antenna, to its existing line of Rangefinder (TM) antennas. It has a high-tensile-strength, stainless-steel whip and includes tunable whips for achieving a low standing wave ratio. It is constructed of chrome-plated brass with heavy copper windings.

The CBA-4 includes a nine-foot dual coaxial cable with a standard PL-259 type plug connector. It has spring-mounting clamps for quick installation and release; all hardware is included.

Suggested list price is $39.95.

For More Details Circle (54) on Reply Card

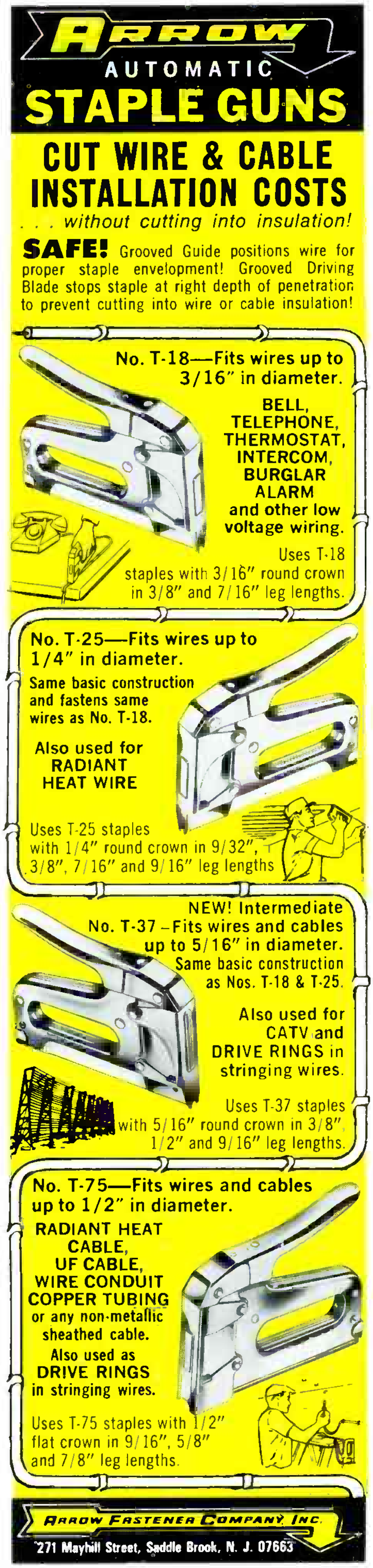
TV Matching Transformer

Blonder-Tongue Laboratories offers a lower-priced 300-ohm to 75-ohm matching transformer for use with antennas or downlead in home TV, MATV, and CATV systems.

The Electrocolor "Setmatch" Model 4005 transformer has the traditional coaxial fitting at one end and twinlead

connections at the other. It can match a 300-ohm antenna to a 75-ohm TV, or a 75-ohm antenna to a 300-ohm TV. Typical insertion loss is only ¾ dB up to 470 MHz. □

For More Details Circle (55) on Reply Card



catalogs literature

Circle appropriate number on Reader Service Card.

80. Heath Company—has a free catalog that includes complete descriptions of over 400 electronic kits—from build-it-yourself color TV and hi-fi equipment to amateur radio gear. Two new products introduced are an electronic digital miles-per-gallon monitor/speedometer, and a low-cost fire and smoke detector kit.

81. Dana Laboratories—a 16-page, four-color brochure describes Dana's full line of 3-1/2 and 4-1/2 digit multimeters. A complete product line recap provides a summary of Dana's other DVM's as well as frequency counters. Included is a detailed accessory listing, as well as a color-coded specification chart covering the 3-1/2 and 4-1/2 digit multimeters, Highlighted is Dana's new 4600 digital multimeter.

82. Breaker Corporation—offers a 12-page, full-color catalog with a Bicentennial theme. The "Freedom" line of 27-MHz mobile, trucker, and base-station CB antennas and accessories is described with many application pictures. A technical reference section provides useful tips on antennas and CB rig operation.

83. Tab Books—free 44-page 1976 catalog describes over 400 current and forthcoming books, plus 14 of the firm's electronic book/kits. Some of the subject matter listed includes: Amateur Radio License Study Guides; Appliance Repair; Basic Electronics Technology; Communications—2-Way, Shortwave and CB Radio; Do-It-Yourself; FCC License Study Guides; Radio Receiver Servicing; Television Servicing; and many other subjects.

84. Mouser Electronics—offers a free 56-page electronics purchasing manual. Electronic components, test equipment, tools and production aids are some of the items featured.

85. Pomona Electronics—announces its 25th anniversary catalog of electronic test accessories. The 76-page publication includes a special new-products section, hundreds of photographs, and separate sections on molded banana plugs, banana plug accessories, molded patch cords, cable assemblies, test socket adaptors, spaced molded accessories, molded test leads, connecting leads, and IC test clips. Special charts cover a cross index of UG numbers, and an alphabetical and numerical index is included.

86. Enterprise Development Corporation—features the full line of Endeco soldering and desoldering equipment in their "Catalog 76". Included are soldering irons, desoldering irons, kits and the desoldering head that converts a soldering iron into a desoldering iron. Also shown are tips, desoldering bulbs, solder paks and soldering tool stands.

87. Cornell-Dubilier—has released their 1976 General Line Catalog and Electrolytic Guide for professional electronic technicians and engineers. The 86-page catalog provides cross references, specifications and configurations. Included are twist prong, electrolytic (aluminum) film dielectric, AC, mica dielectric, ceramic dielectric and DC Kraft. Information on CDE's relays, TV/FM antenna rotor systems and CB noise filters are also provided.

88. Fordham Radio—offers a complete line of electronic equipment and accessories in their 1976 catalog. They specialize in selling test equipment, featuring such names as B&K, Hickok, RCA, Leader, Sencore, Simpson and many others. Considerable savings are offered on receiving tubes, parts, and CB equipment. Also included are parts kits, tools, and soldering equipment. □

bookreview

Electronic Clocks And Watches
Author: Michael S. Robbins
Publisher: Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Indiana 46268
Size: 208 pages, book number 21162
Price: $6.50 paperback (In Canada $7.80)
A brief history of timekeeping is presented, along with some fundamentals of various mechanical, electrical, electronic, and atomic timekeepers. The basic principles of digital logic and its application to electronic timekeeping circuits are explored. The different families of digital logic circuits and readout devices used in clocks and watches are described. Some commercially-available electronic timekeepers are described, and two construction projects for the do-it-yourselfer are presented.
Contents: Some History and Methods of Measuring Time; Electrical Timekeepers; Electronic Time Bases; Digital Logic; Readouts; Large-Scale Integration in Watches; Commercial Electronic Clocks; Digital Electronic Watches; Construction Projects; Manufacturers' Data; Suppliers and Manufacturers; Selected Bibliography; Index.

photofact™bulletin

The MARKETPLACE

Advertising rates in the Classified Section are 35 cents per word, each insertion, and must be accompanied by cash to insure publication.

Each initial or abbreviation counts a full word.

Minimum classified charge $3.00.

For ads on which replies are sent to us for forwarding (blind ads), there is an additional charge of $3.00 per insertion to cover department number, processing of replies, and mailing costs.

Classified columns are not open to advertising of any products regularly produced by manufacturers unless used and no longer owned by the manufacturer or a distributor.

HELP WANTED

$19,000.00 PLUS per year for excellent outside-man. Qualifications: Totally honest, industrious, non-drinker, non-smoker. Prefer 15 years or more experience. If lazy do not apply. Send resume to American Television Service, 1032 South State, Orem, Utah 84057. 10-76-2t

BUSINESS OPPORTUNITY

TV SALES & SERVICE in same location 15 years. Nets over $25,000. Retiring. Including truck, equipment & inventory $25,000. A. Bolin, 6361 Balsam Lake, San Diego, Ca. 92119. 6-76-tf

BOOST PROFITS—Don't turn away business. We repair original equipment car radios. Write: Audio Repair, 2113 Admiral Street, Aliquippa, PA 15001. 9-76-2t

BEAUTIFUL SCENIC MONTANA—Take over 20 year TV Sales and Service business. Gross $45,000. For more details write: Box 370, Red Lodge, Montana, 59068 or call (406) 446-1102. 8-76-3t

EXCEPTIONAL OPPORTUNITY for qualified person to buy well established, AMF mower sales and appliance repair service. Includes residence, van, and inventory. Rogers Realty, 515-753-3433, Marshalltown, Ia. 9-76-2t

ESTABLISHED TV and Electronic Business in small victorian city on the straits of Juan de Fuca. Serves 15,000 people. Test equipment, Photofacts, parts, low rent, busy street. Retiring. $8,500. E. L. Carreau, 240 Taylor St., Pt. Townsend, WN 98368. 10-76-1t

TV SERVICE BUSINESS For Sale in one of the fastest growing areas in U.S. (111% since 1960), Well established, nets $15,000.00, plus unlimited potential for right party. 309 Hwy. 5 No., Mtn. Home, AR 72653. 10-76-1t

TIRED OF CUSTOMER ABUSE? Expand into lucrative patented MATV. Preliminaries $3.00. Box 809, Boynton Beach, FL 33435. 10-76-6t

NEED SECOND INCOME? There is money in re-juvinating picture tubes. Color & B/W. Amazing results. Build re-juvinator costing $200 - $450 from spare parts around shop. Detailed plans & instruction - $6.95. Discount Electronics, Box 1535, Pinellas Park, Fla. 33565. 9-76-2t

EDUCATION-INSTRUCTION

REPAIR TV TUNERS—High Earnings; Complete Course Details, 12 Repair Tricks, Many Plans, Two Lessons, all for $2. Refundable. Frank Bocek, Box 3236 Enterprise, Redding, Calif. 96001. 8-76-tf

TV PROBLEMS? Send symptoms with a COPY of schematic and self-addressed-stamped envelope and $3.00 cash or M.O. (NO checks) to Hart, Box 2041, Downey, CA 90242. Results Guaranteed. 10-76-tf

B/W PANASONIC Troubleshooting Guide filled with actual field breakdowns, '64-75 models. $7.50 ppd. Elect. Pub. Serv., Box 8736, Denver, CO 80201. 10-76-1t

FREE giant bargain electronic catalog listing thousands of components, tubes, transistors, IC's, kits, test equipment. EDLIE'S, 2700-EC, Hempstead Tpke., Levittown, NY 11756. 8-76-3t

FOR SALE

TV & RADIO TUBES 36c EA!! Free color catalog. Cornell, 4221 University, San Diego, California 92105. 8-76-tf

UNUSUAL SURPLUS AND PARTS Catalog. $1. ETCO Electronics, Dept. E.S., Box 741, Montreal "A" H3C 2V2. 7-76-10t

TV TECHNICIANS: Plans for a tripler checker and instructions. Send $2.95; J & S Electronics, P.O. Box 8335, Shreveport, La. 71108. 9-76-2t

PHOTOFACT FOLDER any Radio-Television, $2.50. Lawrence, 1760 Balsam, Highland Park, IL 60035. 10-76-1t

FOR SALE—Heath 1G62 color bar gen. - $45.00, 10-12 scope - $75.00, Sencore 130 tube tester - $50.00, TR15 transistor checker - $7.50, EICO 147 signal tracer - $35.00, Condenser-resistor sub boxes - 4 for $15.00, 30 K.V. probe - $15.00. Quasar complete drawer 80% panels or, power supply. Color picture tube. What am I offered? All manuals for above. Phone 802-899-4442. John Repa Jr., Underhill, VT 05489. 10-76-1t

SENCORE Universal Power Supply 164, never used, original carton. $200.00. TKTV 433 Yorbita Rd., La Puente, CA 91744, (213) 964-1941. 10-76-1t

WANTED

WILL BUY copy (or original) of any factory service newsletters of field & warranty breakdowns covering 1960-1976. Complete sets needed. State price. Write J. C. Reed, Box 2890, Denver, CO 80201. 10-76-1t

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

advertisers' index

FLUKE PROVES AN INEXPENSIVE, HANDHELD DMM CAN BE BUILT WITHOUT LEAVING EVERYTHING OUT.

Let's face it.

Before now, if you bought an inexpensive, handheld digital multimeter you didn't get much— they just left most everything out.

We knew that was no answer.

So we built the 8030A 3½-digit DMM. It's a small, portable, inexpensive, handheld DMM, but it performs like our benchtop units.

With one basic difference. The 8030A was designed, built and tested to a size and shape proven best for field service and laboratory technicians. There's a built-in hood that can be slipped forward to shade the readout in sunshine. It has rms capability. The best overload protection. Diode test. It weighs 2.2 pounds, and will take a beating without failing. Finally, we guarantee accuracy specifications for one year.

And it only costs $235*.

True rms.	Fluke
1-year accuracy specs.	Fluke
High voltage protection.	Fluke
Diode test.	Fluke
A full line of accessories offering rf voltage, high current ac, high voltage dc, and temperature measurement probes.	Fluke

There's only one place to go for all the performance you need in a handheld DMM.

There are measurement functions in five selectable ranges for dc volts, ac volts (true rms), dc current, ac current (true rms), and resistance. DC voltage measurement is from 100 μV to 1100V with basic accuracy of ±0.1%, ac measurement is from 100 μV to 750V rms with basic accuracy of ±0.5%. DC and ac current is from 100 nanoamps to 1.999 amps with basic dc accuracy of ±0.35% and basic ac accuracy of ±1%. Resistance measurement is from 100 milliohms to 2 megohms with a basic accuracy of ±0.4%.

We added true rms response for ac measurements. Specified accuracy is still attainable when the measured waveform is distorted.

"Fluke does the impossible again."

There is extensive overload protection. It has been tested with transients up to 6000V peak across the input terminals.

Options include two battery operations: a rechargeable NiCad for 8 hours operation and throw-away alkaline cells. Accessories include probes for measurement of rf voltages, high current ac, high voltage dc and temperature.

80T-150 Temperature Probe	
Sensitivity:	1 mV/°C or 1 mV/°F
Accuracy:	
+15°C to +35°C ambient:	±2°C(3.6°F) −25°C to +125°C ±3°C(5.8°F) −50°C to −25°C and +125°C to +150°C
0°C to 15°C, 35°C to 50°C ambient:	Add 1°C(1.8°F) to above

You can also get temperature measuring capabilities with the 8030A.

And because the 8030A gives you so much in performance, let us remind you once more of the price.

Only $235*.

For the first handheld DMM that's small in size, small in price, but huge in performance.

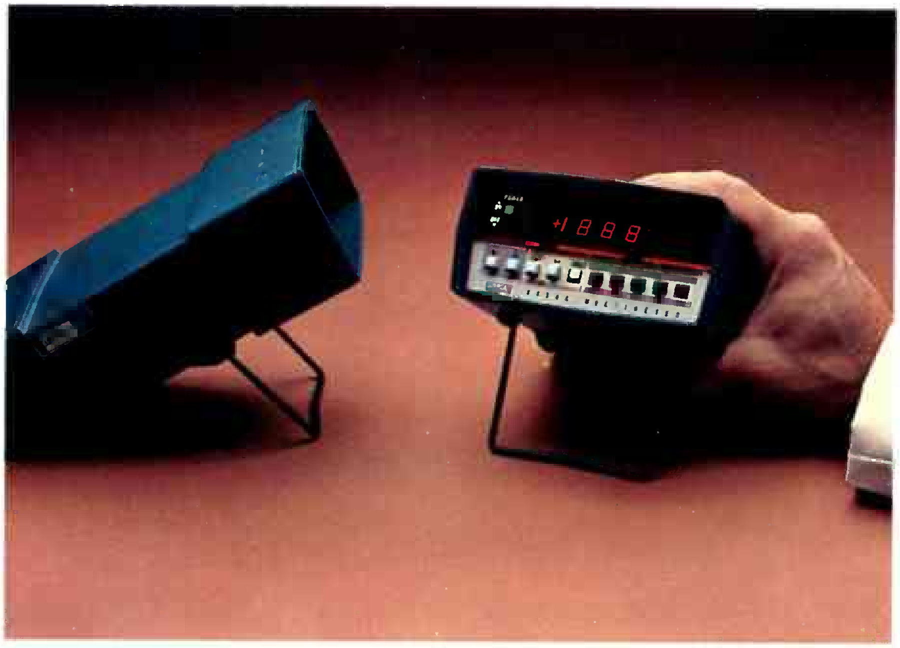
For data out today, dial our toll-free hotline, 800-426-0361.

John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA 98043

Fluke (Nederland) B.V., P.O. Box 5053, Tilburg, The Netherlands.

Phone: (013) 673-973 Telex: 52237

*U.S. price only.



A NEW ADVANCE. 8030A DMM. FLUKE®